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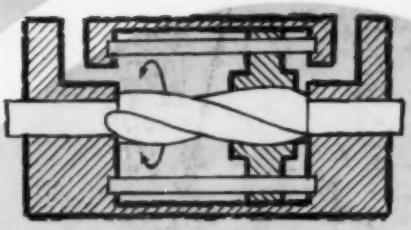
AUGUST 1960



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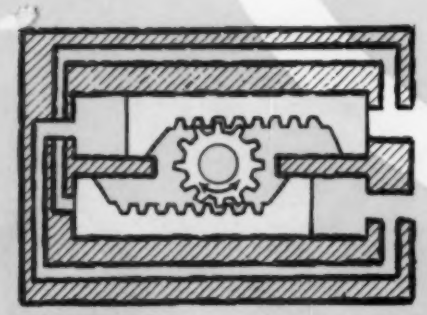

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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

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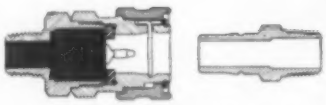

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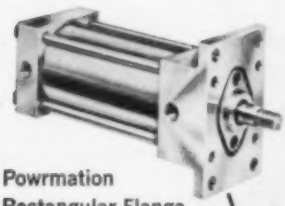

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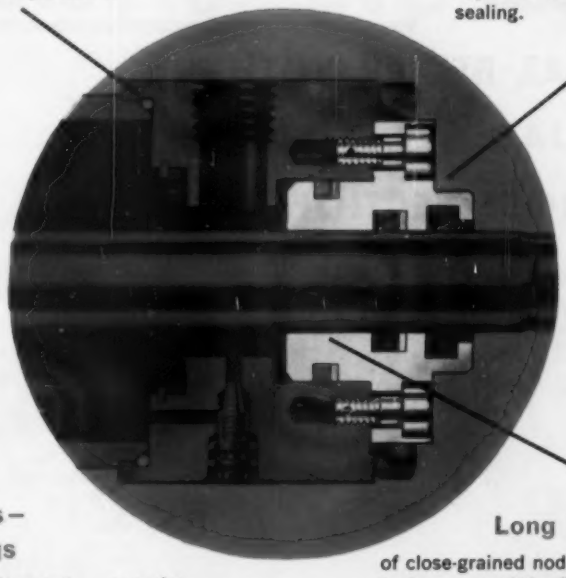

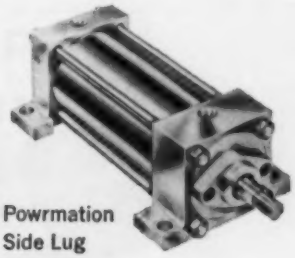

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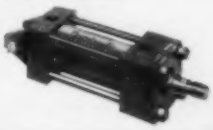

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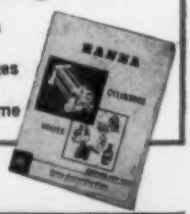

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VOLUME 13/NUMBER 8

AUGUST 1960

THE MAGAZINE OF FLUID POWER

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PIPE SIZES: ¾"—1"—1¼"—and 1½" (at both inlet and outlet).
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Series 1650
2-Way Solenoid Valves

An entirely new Waterman principle in A.C. Solenoid Valves *eliminates* inrush current, makes possible fast cycling without overheating, minimizes wiring requirements. Specify Waterman Series 1650 Solenoid Valves for your next circuit design.

These valves, in ⅜" and ¾" sizes, are pilot-operated poppet type, for wider valve opening, low pressure drop. Bodies are high-strength aluminum alloy, for pressures to 3000 p.s.i. Working parts are hardened and ground steel. Seating surfaces lapped together for maximum leakage of 5 drops per minute. All working parts totally enclosed and immersed in the hydraulic fluid.

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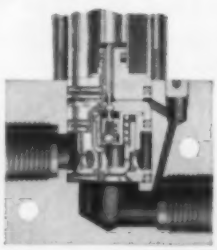

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USEFUL LITERATURE

NEW, REVISED ANCHOR HYDRAULIC HOSE ASSEMBLIES CATALOG

A completely revised and enlarged catalog covering Anchor Hose Assemblies—Catalog No. 102—has been issued by Anchor Coupling Co. Inc.

Replacing Catalog No. 101, this new 44 page catalog describes in detail Anchor permanently applied industrial hose assemblies and couplings for use with fluid power equipment in such fields as agricultural, earth moving, mining, frame straightening, materials handling, greasing, fire fighting, oil field, machine tools and automotive.

Fabricators of Coupled Hydraulic Hose Assemblies, Anchor introduces in Catalog No. 102, their completely new Super-Spiral 4-ply and 6-ply Wire Reinforced Hose for extreme high pressures, a long sought objective of hydraulic equipment users.

The new Anchor Super-Spiral Wire Reinforced Hose Assemblies are available from 3/16-inch to 2-inch I.D., and for recommended working pressures ranging from 12,000 PSI for 3/16-inch, 6-ply hose to 2,000 PSI for 2-inch, 4-ply hose. They can be furnished with different styles of Anchor Pressed-On Couplings.

Other standard Anchor high, medium and low pressure hose assemblies are fully described and listed in Catalog No. 102. Also included is a wealth of engineering data to assist fluid power equipment users, such as Flow Charts, Thread Information, etc.

Copies of Catalog No. 102 will be sent, on letterhead request, by writing Anchor Coupling Co. Inc., 349 N. Fourth Street, Libertyville, Illinois.

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for **VHP** VERY HIGH PRESSURE

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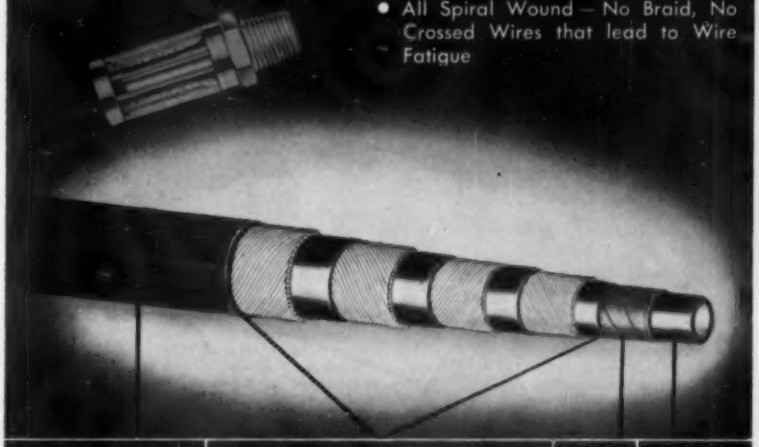
- 4 or 6 plies of Spiral Wound Wire Reinforcement
- Maximum Working Pressures from 12,500 PSI (3/16" I.D. — 6 Ply) to 2000 PSI (2" I.D. — 4 Ply)
- Heavy Wire, .022" Dia. Reinforcement
- All Spiral Wound — No Braid, No Crossed Wires that lead to Wire Fatigue



OIL AND WEATHER RESISTANT SYNTHETIC RUBBER COVER	4 or 6 PLIES OF SPIRAL WRAPPED HEAVY WIRE (.022" DIA.)	PLIES OF WOVEN FABRIC	OIL RESISTANT NEOPRENE INNER TUBE

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"The Anchor representative is a specialist in fluid power transmission who is always available for consultation on any of your problems."

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. . . after 25,000,000 cycles!

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... Fluid Power news

REPORT NO. 12,107
HYTAC* **AIDS MAKING OF NEW EXTENSIBLE PAPER**

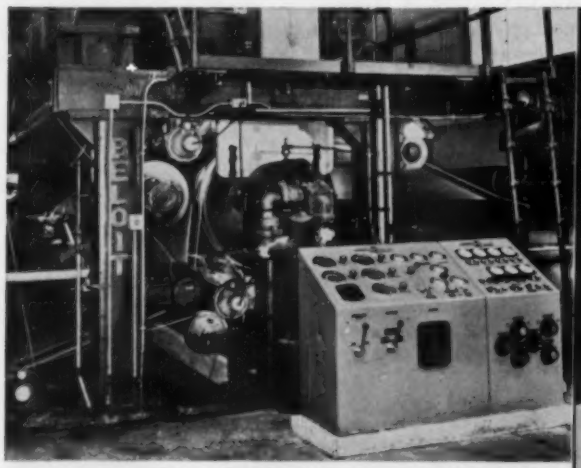
From Oilgear *Application-Engineering* Files

HOW *HYTAC** SYSTEMS CONTROL NEW EXTENSIBLE PAPER MACHINE SECTION SPEEDS IN 12 MILLS

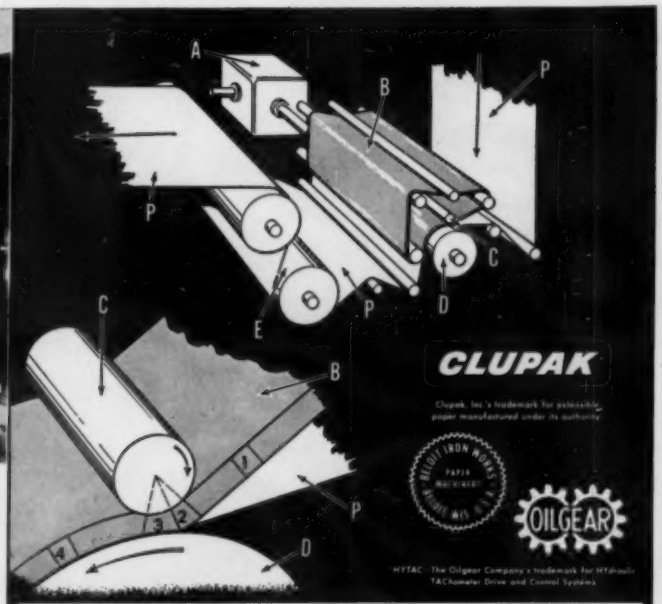
USERS: *Twelve Paper Companies—Licensed by CLUPAK, INC.*

Builder—Sections and Differential Drives—Beloit Iron Works, Beloit, Wisconsin

DATA: Systems to vary and precisely control speed and draw of new sections that can be an integral part of complete, new paper machines, or inserted into existing machines for production of CLUPAK® extensible paper—a revolutionary, patented, smooth, tough, kraft sheet. Original requirements called for systems that, when applied to *Beloit* mechanical differentials, would: *1.* Provide precision-controlled, infinitely variable section speed decrease up to 10% under main lineshaft speed—as selected from remote pushbutton stations. *2.* Maintain selected section speed within ±0.25% max. variation over a 50% load change at max. lineshaft speed. *3.* Be: compact; impervious to heat, high humidity; thrifty on electrical power input, wiring, installation downtime, floor space; completely free, if possible, from maintenance-provoking belts, chains, relays. *4.* Insure trouble-free, continuous, heavy-duty, full-production paper machine drive service—but permit section immobilization for production of non-extensible stock. *5.* One source and responsibility for these speed and draw controls preferred.



One of the most recent of the twelve new **Beloit** extensible sections and control consoles incorporating **HYTAC* SYSTEMS** for precise speed and draw control—as installed on No. 1 machine at **International Paper Company's Southern Kraft Division Mill, Camden, Arkansas,** to produce CLUPAK® extensible paper. Control console instrumentation includes direct-reading hydraulic pressure gages from the **OILGEAR System** to provide operators with constant, visual, exact indication of load or draw on the section.



HOW IT WORKS: Section driven by Oilgear-equipped **Beloit** differential (A), consists of a 1-in. thick natural rubber Blanket (B) operating over 3 rolls, and between Nip Roll (C) and steam-heated, polished, chrome plated Dryer Drum (D). Paper (P) is held between Blanket (B), slipping against Dryer Drum (D). Enlarged view at Nip Roll shows how normal (1) Blanket (B) is compressed (2), squeezed and elongated (3), and rapidly contracts (4) after leaving Nip Roll—shrinking paper. Normal production shrink requirement is accurately controllable up to 15% by controlled variation in nip pressure, moisture content, dryer drum temperature. Accurate control of draw in and between extensible unit and 3rd Dryer Section (E) is required regardless of load changes . . . a reason for the precise, infinitely variable speed-draw control provided by Application-Engineered **HYTAC* Systems.**

SOLUTION: Application-Engineered *HYTAC** (HY*draulic* TAC*hometer*) controlled differential drives consisting of Oilgear "DRt-3517" Variable Displacement Pumps, "H-6017" Constant Displacement Motors, and *HYTAC** components with remote pushbutton control to provide precise speed-draw control on *Beloit* extensible sections installed and commercially producing CLUPAK® extensible paper at nine mills in the United States, two in Canada, and one in Sweden. Several other paper manufacturers licensed by CLUPAK, Inc., to produce extensible paper under its authority, now have these Oilgear-equipped *Beloit* extensible sections on order. Oilgear *HYTAC** Drive-Control Systems were selected after 3 years of development on this process and machine—from a 2-in. table model, through a 15-in. laboratory model, and a 60-in. pilot model—as best suited to provide the accuracy and range of control required for the variable speed drives. *Actual commercial operation has proved that these highly accurate, compact, heavy-duty, Oilgear Systems can maintain any selected section speed with less than ±0.25% variation* regardless of load change *over a 10:1 range of lineshaft rpm—plus enabling operators to infinitely vary each section's drive rpm up to 15% under main lineshaft rpm . . . exceeding originally specified requirements!*

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You can handle increased pressures . . . higher shaft speeds *and* most high temperature applications with F-C seals and packings. Special molding machinery and techniques have been developed by I.P.C. to produce this combination. Synthetic rubber, fluorocarbon plastics and steel cases are brought together in one operation to provide the last word in high quality case seals.

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PRECISION MOLDING
Custom designed for your application.

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P4

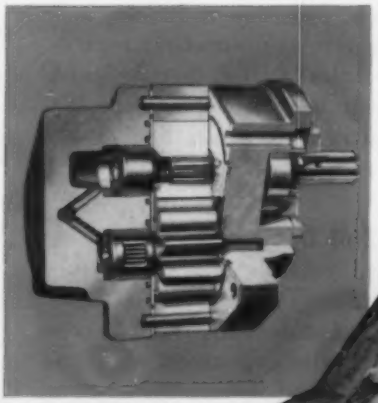
Webster hydraulics "muscle" a boardinghouse reach . . .

It stretches way out for a hearty bite, digs deep and unloads high over a truck side. Hydraulics give this versatile backhoe its sure-footed stance, swivel-hipped performance, accurate bucket and boom control. In many of these mobile rigs, a Webster JD hydraulic pump powers the action — in up to seven separate cylinders!

Not an unusual assignment — for the JD series has an uncanny ability to handle demanding jobs with speed, sureness and exceptional dependability. That's why you find them on a wide range of industrial, agricultural and construction machines . . . in pressure lubricating, oil circulating and lift systems.

Webster JD positive displacement, gear-type pumps are available in 5 sizes — from 5 to 23 gpm — with pressures to 2000 psi, speeds to 2400 rpm. Drive is direct, gear or belt. Side porting standard, end optional. Compact design fits into tight corners.

Need help in a specific hydraulic application? A specially trained Webster hydraulics engineer is ready to assist you. Write for action!



JD SERIES POSITIVE DISPLACEMENT GEAR-TYPE PUMP — Send for complete engineering characteristics performance and installation data.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS

FLUID POWER LINES

about hydraulics & pneumatics

BY ANY OTHER NAME . . . Call them what you like: rotary cylinders, oscillating motors, or rotary actuators (as we have) these components have plenty of applications. We think that many of these applications are still to come, so to give you a better acquaintance with rotary actuators, we've compiled a manual on designs and typical applications.

How many times have you used a cylinder to drive a rack and pinion for rotary motion, when a rotary actuator could have done the same job in less space? How many times have you needed a torque output to 22,000 in-lb/100 psi through part of a circle? Did you consider a rotary actuator? Were you familiar enough with them to know if one could do the job better than your final design?

Rotary actuators are being used successfully on machine tools, foundry equipment, aircraft, mobile equipment, and many types of industrial production machines. After a rundown on basic actuator designs on page 64 with a table showing performance, you'll find a roundup of applications that may suggest others you should be making.

AN INTERNATIONAL PROBLEM . . . Winding up extruded wire is a problem, *wherever* you are. Extrusion speed depends on billet length, extrusion resistance, and temperature. But tension must remain constant, regardless of speed. At Israel's Technical Office, they designed a pressure compensated pump for this application. It's described in *Hydraulic Coiler Reciprocates and Holds Constant Tension.*

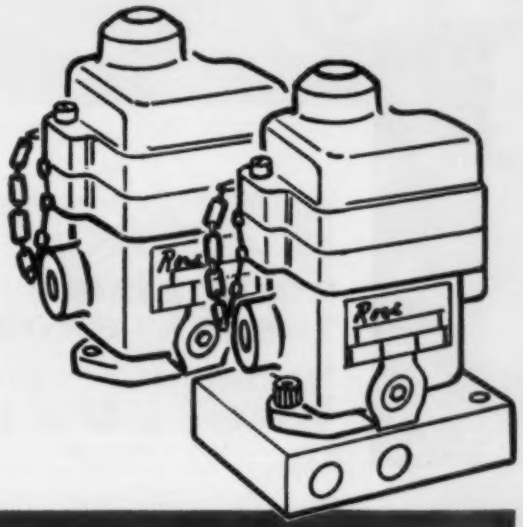
MR. TROUBLE . . . Part 2 of Don Fitzpatrick's 3-part series on applying electrical controls appears in this issue. Part 1, *Why Solenoids Burn Out,* was in June. Part 3, *Relay Circuitry* comes up in October. In his job as consultant to the engineering and sales department of Allen-Bradley Co., Don learns a lot about how electrical components are designed and used. One of his main objectives is to get users to apply these controls properly. Background for this interest comes from eight years of teaching electrical engineering at Purdue and five years at Allen-Bradley. Last year he was sponsored by the National Electrical Manufacturer's Association and attached to the Department of Commerce to represent the U. S. electrical industry.

SKIMMING THE FOAM . . . Most of us know that air in a hydraulic system makes foam, and causes spongy action. At the Naval Air Material Center in Philadelphia they've gone beyond this qualitative evaluation and studied the effects of time and pressure on the amount of dissolved air. They've tested both petroleum and fire-resistant fluids. The project is described on page 80.

A PLACE IN THE SUN . . . Fluid power technology has reached the point where those working in this field need an organization of their own. So the Fluid Power Society has been formed to bring together designers, educators, application engineers, manufacturers, and all others interested in hydraulics and pneumatics. Page 31 has more information on this new group, and how you can join.

The Ross PACER gives you 56 new solenoid air valves

The Ross PACER is a fine new solenoid valve in the ⅛" and ¼" size range that gives a full $\frac{7}{32}$" flow capacity yet uses only 7 watts of holding power. The PACER is built for especially long life yet is priced surprisingly low. Capable of 1000 cycles per minute and more, is JIC, and very light and compact. And if you're interested in large valves the PACER has a second identity, that of a pilot section to actuate *any* valve of the Ross Skyline series. It will operate any of these valves at top speed and with low power consumption.

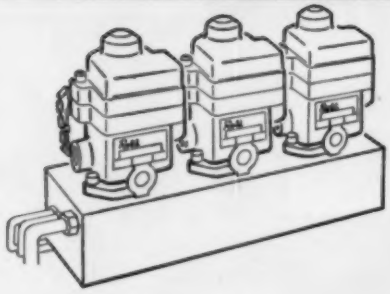


As well as being a complete new valve

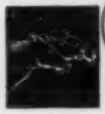
...PACER is also a new pilot section in the Ross Skyline valve series...

COMPLETE PACER VALVES	PIPE SIZES ⅛"	¼"	⅜"	½"	¾"	1"	1¼"
STRAIGHTWAY, N/C	√	√					
3-WAY, N/C	√	√					
4-WAY	√	√					
SKYLINE VALVES USING PACER AS ACTUATOR (HEAD)							
STRAIGHTWAY, N/C		√	√	√	√	√	√
STRAIGHTWAY, N/O		√	√	√	√	√	√
3-WAY, N/C INLINE MT.		√	√	√	√	√	√
3-WAY N/O, INLINE MT.		√	√	√	√	√	√
3-WAY, N/C, BASE MT.		√	√	√	√	√	√
3-WAY, N/O, BASE MT.		√	√	√	√	√	√
4-WAY, INLINE MT.		√	√	√	√		
4-WAY, BASE MT		√	√	√	√	√	√
4-WAY, 5-PORT		√	√	√	√		

New **PACER** manifolds to save piping and wiring



Ross manifolds provide a compact and economical method of multiple mounting PACER valves. One air supply line and one electrical conduit can serve all PACER valves. Manifolds are available in two and three stations.



ROSS OPERATING VALVE COMPANY
EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

ENGINEERED TEFLON* PRODUCTS

for Hydraulic-Pneumatic Service

For top efficiency and little downtime, apply Garlock Teflon Packings wherever fluid power is used.

CHEVRON†Packings of solid Teflon—or rubber, coated with Teflon—are as close to "frictionless" as you'll find. First of all, Teflon has the lowest coefficient of friction of any solid material in use today. Moreover, the CHEVRON itself is designed to permit free operation with minimum friction at all pressures. Here's how: with increasing pressures, CHEVRON packing rings tighten to prevent leakage. As pressures decline, the rings instantly ease off, permitting free operation of the rod, ram, or piston without leakage. This exclusive hinge-like construction lengthens packing life and, with proper initial adjustment of the gland, eliminates all further adjustments necessary to compensate for pressure variations. Catalog AD-115.

Teflon "V" Rings for higher pressures. Flexible enough to respond quickly to low gland and fluid pressures due to tapered "V" design.

"O" Ring Packings made of solid Teflon or rubber, coated with Teflon provide exceptional anti-friction qualities on equipment where a round-bodied seal is required. And, a new slotted Teflon ring is available to simplify installation in standard AN grooves. Catalog AD-148.

Teflon-Coated Cups—the first advance in cup design in thirty years. Garlock has perfected a technique whereby cups are coated with a thin layer of Teflon which then becomes an integral part of the cup. Teflon-coated cups reduce breakaway and running friction, and completely eliminate "squealing." Catalog AD-145.

GARLOCK

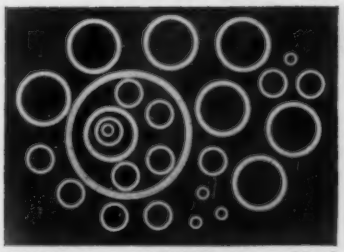
Other fine advantages of Teflon packings: Solid Teflon is chemically inert, non-flammable, resilient, long wearing. It can be applied against new synthetic hydraulic fluids at temperatures ranging from −100°F to +500°F.

Discuss Garlock Teflon Packings with your local Garlock representative. Call him at the nearest of Garlock's 26 sales offices and warehouses throughout the U.S. and Canada, or write Garlock Inc., Palmyra, N. Y.

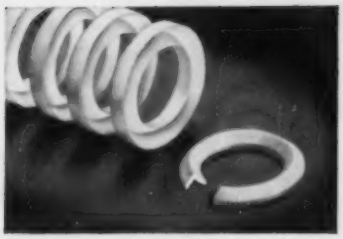
Canadian Div.: Garlock of Canada Ltd.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

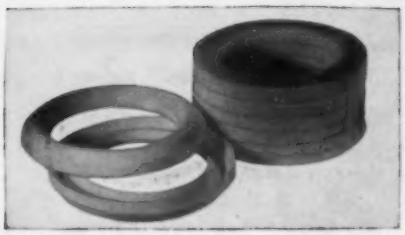
†Registered Trademark *DuPont Trademark



"O" Rings are applied where round-body static or dynamic seals are required



"V" Rings are used as piston or stuffing box seals against reciprocating and oscillating motions



CHEVRON Packings assure positive seal on rams, plungers, reciprocating rods

Teflon-coated cups reduce breakaway friction on inside-packed reciprocating pistons

Barksdale AIR-SEAL* Valves for the nerve centers of production

** The air pressure is the sealing force; the higher the pressure, the tighter the seal.*

DIRECT SOLENOID 4-way, 3-way, shut-off and diverter valves

◆ Standard **AC**

Explosion-proof **AC** ◆

◆ Standard **DC**

Explosion-proof **DC** ◆

SOLENOID-PILOT 4-way and 3-way valves

◆ Standard **AC**
◆ Standard **DC**

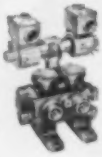
Explosion-proof **AC** ◆
Explosion-proof **DC** ◆

MOMENTARY CONTACT solenoid-pilot valves

◆ Single Solenoid

Both types available in standard AC and DC and explosion-proof AC and DC.

Dual Solenoid ◆



MANUAL OVERRIDES for standard solenoid-pilot valves

◆ "L" type manual override

"MK" type manual override ◆

MANUAL and FOOT OPERATED valves

Manual 4-way

Manual shut-off

Foot operated 4-way

Write for air valve catalog (AV-9) which contains complete data and prices on 562 different valves (not counting voltage variations).

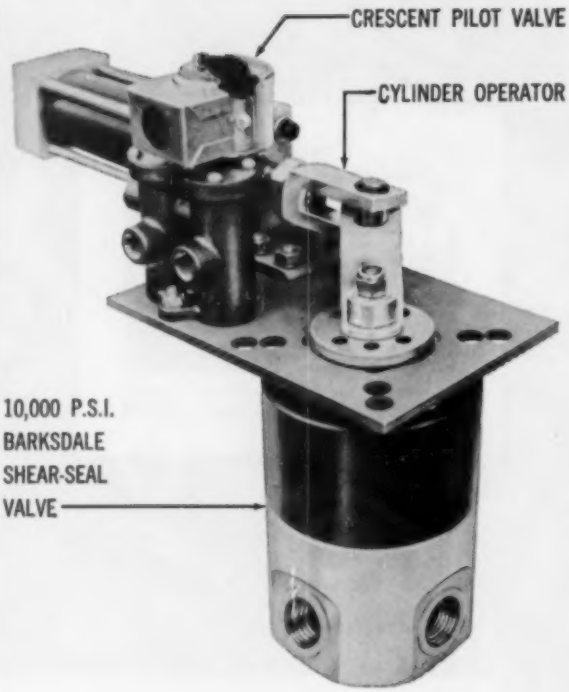
CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **17** on Time-Saver Card

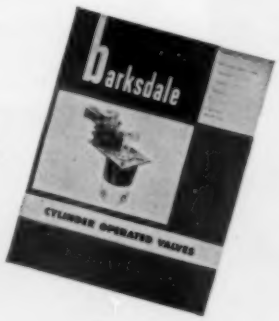
CYLINDER OPERATED "SHEAR-SEAL" VALVES



Remote control operators for 10000 P.S.I., 6000 P.S.I. and 3000 P.S.I. "Shear-Seal" Valves are available with cushioned or non-cushioned cylinders.

4-Way, 3-Way and Shut-off valves range in pipe sizes from ¼" to 1½" N.P.T.

For complete data request catalog COV-60-61.



CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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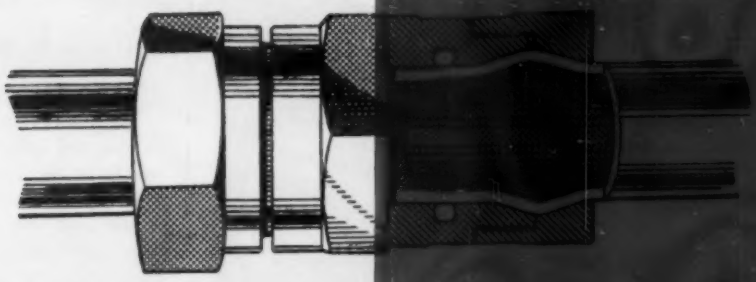
KEELAVITE
Hydraulics

HIGH PRESSURE PIPE COUPLINGS

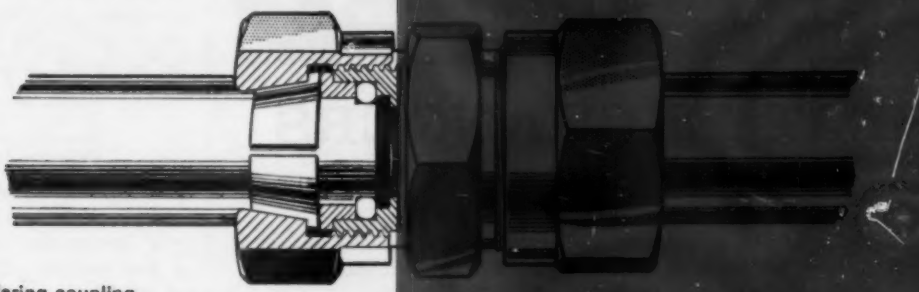


Keelavite Hydraulics, the recognised authority on hydraulic power transmission, needed high pressure pipe couplings, to meet the high standards required for their successful hydraulic installations, result—THE KEELATITE COUPLING and THE KEELARING COUPLING.

THE KEELATITE COUPLING

The Keelatite coupling provides a simple, safe and sure way for speedy hydraulic pipework. Absolute reliability under steady and fluctuating pressures. Tube-end is formed hydraulically by a quick and effortless operation.

THE KEELARING COUPLING



The new Keelaring coupling is a collet type joint consisting of five separate pieces. When assembled the sealing ring is forced into a tapered recess thus providing a leak proof seal. Adequate tightening is possible with standard tools.

Each coupling has its special characteristics and uses, but both are equally successful. Designed to provide perfect sealing and to withstand vibration.

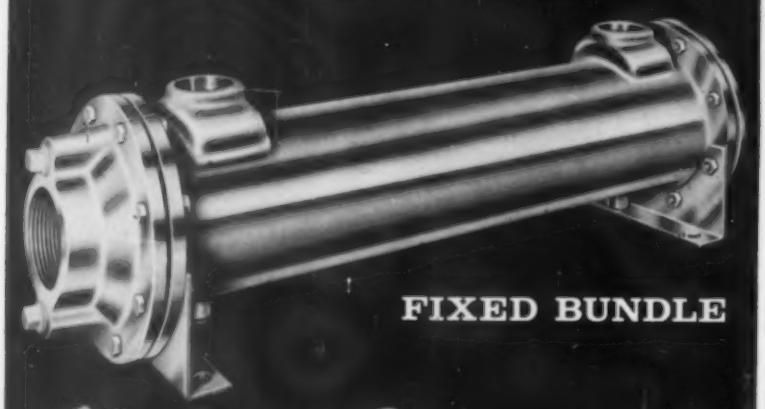
THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

For full details write to

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD., ALLESLEY, COVENTRY, ENGLAND
Telephone: Meriden 441

FOR CORROSIVE TYPES OF HYDRAULIC OILS...



FIXED BUNDLE

Yates-American STAINLESS STEEL

HEAT EXCHANGERS

- Stainless Steel Construction . . . all parts in contact with fluids . . . of Type 316 stainless steel.
- Rolled tube joints . . . industry's preference and standard of quality construction.
- Tube pattern . . . allows for use of wider, heavier gaskets for critical conditions of temperature and pressure.
- Wider range of capacity . . . ¼" and ⅜" tube sizes . . . unit sizes 2" to 10" diameter.

WRITE FOR BULLETIN HT-21

Over 75 years of service to industry

HEAT TRANSFER DIVISION
Yates-American MACHINE COMPANY
705 4th St. BELOIT, WISCONSIN

HEAT EXCHANGERS / RADIATORS / AFTERCOOLERS

Circle 118 on Time-Saver Card

LETTERS to the editor

Address your letters to: Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Design data for air power

TO THE EDITOR:

We are anxious to obtain tables, curves and other information for use in connection with the design and testing of air equipment. We would like you to inform us of any publication which gives a comprehensive guide for use by the air power designer. We are also interested in practical methods of determining the air output of various types of compressors up to 1000 cfm, and to do this in the field.

We are aware of the formula for computing orifice sizes which can be matched against a pressure drop to give an approximate air capacity, but we feel that this type of measuring is clumsy and probably inaccurate. If you know of any standard instrument or instruments which are available, and which are capable of being carried in the pocket, please advise us.

G. PICKLES
Hydraulic & Pneumatic Dept.
Hoey Fry Pty., Ltd.
Brisbane, Australia

Regarding the design and testing of air equipment, we suggest you contact the Compressed Air & Gas Institute, Cleveland, Ohio. A further suggestion is that you contact manufacturers of test equipment, compressors, and instruments. Undoubtedly their engineers can analyze your specific problem and work out suitable solutions.

Needs textbook

TO THE EDITOR:

I am an industrial engineer and consultant in the field of automation with the Industry Organization of T.N.O., a nation-wide institute for Applied Scientific Research in the Netherlands. It is in this capacity that, in 1958, I had the privilege to be chosen

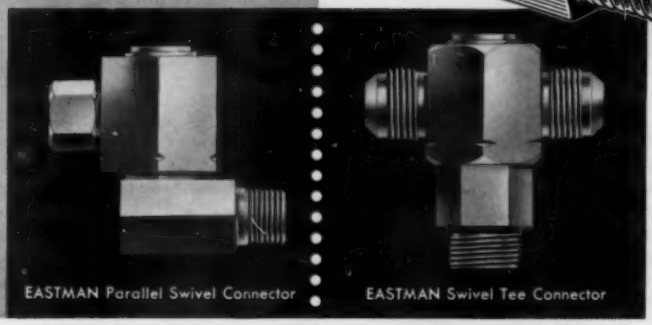
Continued on page 20

Eastman
improves INDUSTRIAL SWIVEL CONNECTOR

Licensed Under
Pat. No. 2481404

AMAZING VERSATILITY AND ADAPTABILITY!

These two adaptations, specified by two of America's largest major equipment manufacturers, reveal the unique adaptability and versatility of EASTMAN'S improved Industrial Swivel Connector.



EASTMAN Parallel Swivel Connector

EASTMAN Swivel Tee Connector

improves **SEALING QUALITY**
through use of SIX seals, thereby eliminating failure from grit, dust and other foreign materials.

improves **SERVICE LIFE**
through new design and engineering, the interior is chrome-hardened with a highly polished mirror finish.

improves **UNIFORMITY OF FLOW**
at any angle of the swivel by undercutting the shaft to equal diameter of the orifice.

improves **SERVICEABILITY**
through shorter, more compact housing; saving weight. Hex design permits multiple tapping on housing; easier assembly.

While the use of EASTMAN'S High Pressure Industrial Swivel Connector eliminated the cause of hose failure due to constant, extreme flexing, it tended to increase the load on the swivel connector.

To improve the performance of the swivel itself, EASTMAN engineers improved its internal design, chrome-hardened its interior surfaces, cadmium plated the shaft and then machined them to a mirror-like finish.

Satisfactory service under the most unfavorable field conditions was insured by increasing sealing rings from four to SIX: 2 leather dust seals, 2 synthetic back-up washers and 2 quad rings of oil-resistant rubber (−65° to +250°).

Exhaustive tests at 3000 p.s.i., through one million cycles, with the hydraulic fluid *saturated* with abrasives, dirt and other foreign materials, proved EASTMAN'S Industrial Swivel Connector satisfactory in every respect and did not cause failure of any kind.

That is why America's leading OEM's and replacement buyers specify *complete* EASTMAN Hydraulic Hose Assemblies . . . for improved design, quality manufacturing and exhaustive testing. It pays to specify EASTMAN.

STANDARD SIZES AND COMBINATIONS AVAILABLE

LOW TORQUE—Freedom from friction, even under high pressure.

WIDE RANGE—Operating pressures up to 5000 p.s.i. trouble-free operation through wide temperature range (−65° to +250°).

ROTATION—Full 360° for all manifolds.

SIZES—Steel, plated for corrosion protection—½", ¾", 1", 1¼".

Other sizes available on request.

LOOK INTO EASTMAN'S IMPROVED SWIVEL CONNECTOR—WRITE TODAY!

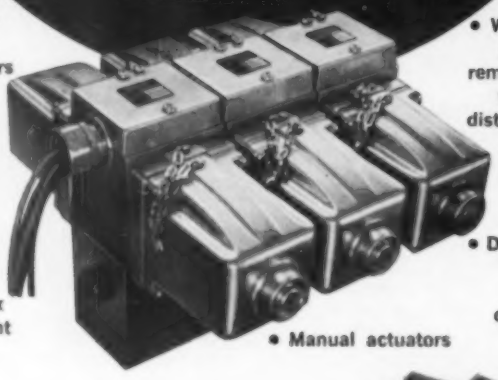
Please send me Bulletins 100 and 200 on low, medium and high pressure assemblies.

Eastman MANUFACTURING COMPANY
DEPT. AH-8, MANITOWOC, WISCONSIN

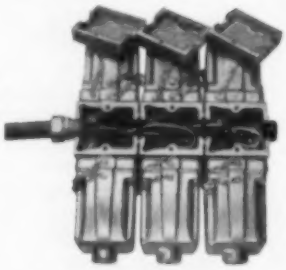
NEW!

BECKETT HI-CYCLIC

3/8" DIRECT ACTING SOLENOID VALVE FOR MANIFOLD MOUNTING



- Compact—mounts on 2⅝" centers—up to 5 units on a manifold.
- When multiple mounted can remove an inner valve without disturbing wiring of other valves.
- Built-in electrical junction box—vapor-tight seal.
- Direct solenoid operated—industrial, constant duty type.
- Manual actuators



- With junction box covers off, valve design provides wide open conduit for easy installation of wiring. All wiring readily accessible.
- Solenoid and junction box covers chained to valve body.

TYPE:

⅜" capacity double or single solenoid, spring return — fast reaction for accurate control.

2, 3, or 4 way, 2 or 3 position.

7 spool types available to meet all requirements.

Furnished with standard equipment or to JIC standards.

MEDIA:

Air, vacuum and all conventional hydraulic fluids.

NFPA MEMBER

WRITE TODAY FOR DETAILED INFORMATION

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BECKETT-HARCUM CO.

981 W. LOCUST STREET, WILMINGTON, OHIO

Circle **22** on Time-Saver Card

LETTERS

among the 18 member countries of the European Productivity Agency—O.E.E.C. organization—as the European consultant lecturing for the E.P.A. seminars in their "Low Cost Automation" project.

In June 1959, the tragic death of Professor Linsky of Pennsylvania State University left me the sole responsibility of the project up to January 1960. Now I am here in this country to wind up Professor Linsky's work and to make a survey of the very interesting teaching methods and application of this subject matter. At the Automation Laboratory of Penn State I came across the very interesting book "A Beginner's Course in Basic Pneumatics", published by you. I understand that this is considered a very good book for education purposes and I fully agree with that.

I would appreciate your sending me this book. Also I have read many very interesting articles in your magazine. I understand most of the important ones are available as reprints. Could you send me those that in your opinion would be of interest to me.

RIJN DE GROOT
c/o Automation Laboratory
Pennsylvania State University
State College, Pa.

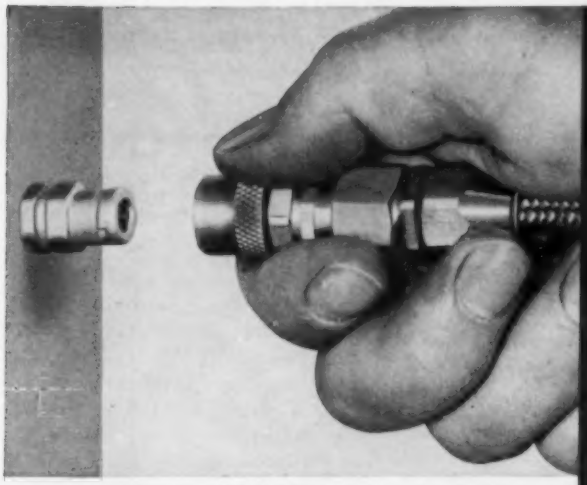
We are sorry that the "Beginner's Course in Basic Pneumatics" is no longer available. Maybe one of our readers can send you a copy that's no longer needed. We have sent you our May 1960 issue which concentrated on assembly machines.

New product correction

TO THE EDITOR:

We were very pleased to have the Model 20 Series torque motors appear as a new product release in your June, 1960 issue of HYDRAULICS & PNEUMATICS. However, the weight of the units should be from 2.8 to 18.5 ounces rather than pounds as stated on page 116.

NICHOLAS D. TRBOVICH
President
Servotronics, Inc.
Buffalo 25, N. Y.



This miniaturized Self-Sealing Coupling on an Aeroquip Teflon Hose Line assures fast, leak-proof connections on the coolant system of an electronic unit.

Aeroquip's Wide Range Of Self-Sealing Couplings Improves Connections On Any Fluid System

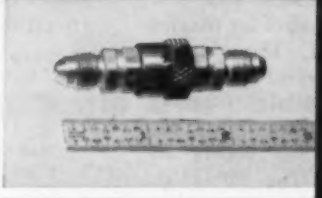
Aeroquip has developed hundreds of Self-Sealing Couplings for standard and specialized applications. Whatever your requirements, there's an Aeroquip Coupling, or a modification, which will provide better fluid line connections and disconnections.

For assistance in solving special problems, Aeroquip's large and long-experienced Engineering Staff is at your service. Mail the coupon below for information.

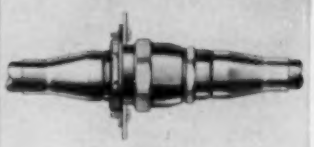
5600 Series PUSH-PULL Coupling provides quick connections on hydraulic, lube oil, air and water lines. It is available for ⅛" to 1" hose lines at working pressures up to 3000 psi.

5100 Series Threaded Coupling for a wide range of applications where connection under pressure is required. Available for ¼" to 2" hose lines with pressures to 3000 psi., depending on size.

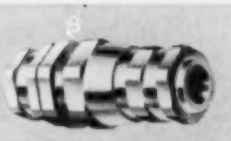
1010 Series Miniaturized Coupling is designed for connections in confined areas. Precision-built, lightweight (.037 lbs.) and compact, it fits ¼" O.D. tube size.



3900 Series PUSH-PULL Coupling combines leak-proof operation with quick, easy connections. Available in sizes up to 1½", it may be used with many low lubricity fluids.



5500 Series Refrigerant Coupling permits precharging and storage of components for remote package units. It is available in sizes from ¼" to 1⅛" O.D. tube sizes.



5400 Series Refrigerant Coupling simplifies assembly line installation of precharged automotive air conditioning systems. Available in O.D. tube sizes from ¼" to 1⅛".

Series 5900 QUICK-LOADER Marine Coupling connects and disconnects quickly to provide fast transfer of liquid cargo without spillage. Sizes for 6" to 12" lines.

Series 510038 Railroad Coupling for Aeroquip Automatic Fueling Unit eliminates fuel spillage or overflow. Coupling feeds fuel quickly, shuts off automatically.

QUICKLOADER and PUSH-PULL are Aeroquip Trademarks.

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O-M IMPROVED TIE-ROD HEAVY-DUTY HYDRAULIC (OIL) CYLINDERS 2000 PSI 3000 PSI NON-SHOCK MEET JIC STANDARDS BULLETIN 105A

MAINTAINING perfect piston rod alignment on thrust and return strokes is an engineering advantage of all O-M Air and Hydraulic Cylinders. But this is not the only reason why Design Engineers specify these components. For example, O-M Cylinders are all steel with bronze bearings . . . are cushioned to relieve piston shock . . . make full-power starts, and the length of each stroke can be held to the tolerance desired. In addition, O-M Cylinders can be mounted to deliver maximum performance in a horizontal, vertical or inclined position, and ports oriented to a convenient location.

These and many other advantages of O-M Cylinders are covered in our 1960 Bulletins with construction and dimensional details, engineering drawings, capacity chart and mounting data. For your copies, MAIL COUPON TODAY.

Bulletin 101A— Internal Key Tie-Rodless-Type Cylinders. Air 150 psi; Hydraulic up to 1500 psi.

Bulletin 105A—Improved Tie-Rod (Heavy Duty) Cylinders. Hydraulic 2000 psi; 3000 psi non-shock.

Bulletin 107—Automation (Heavy Duty) Air Cylinder for 200 psi operation.

Bulletin 108—Automation (Heavy Duty) Hydraulic Cylinder—for 1000 psi operation.

All O-M Cylinders are available in 1½" to 8" bores with standard or heavy-duty rods. Complete line of mounts and interchangeable parts. Immediate delivery on most sizes. **MAIL COUPON TODAY**

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Circle **88** on Time-Saver Card

FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

• *Have you been troubled by shock? How have you reduced it? —accumulators, decompression, improved deceleration valves, special directional valves or circuitry?*

The United States Army Engineer Research and Development Laboratories have recently developed an Armored Vehicle Launched Bridge and Transporting Launcher. This unit consists of a 63-foot span scissoring type bridge mounted on an M48 turretless tank chassis. The bridge is unfolded and placed across a gap by means of hydraulically actuated pivoting mechanisms.

The AVL bridges are currently being tested and a number of failures have occurred to the working sections of the hydraulic cylinder control valves. The design originally called for a valve bank of four working sections, each having directional control for parallel circuit operation. The working section is of a spool type, lever operated, and contains four-way manifolding for three-lever position operation. The spools are spring centered. The valves are used to direct fluid to actuate double acting cylinders which normally operate at a 3500 psi working pressure. The flexible hydraulic lines leading to the cylinder ports contain adjustable setting pilot control relief valves with a return line to reservoir.

The lower portions of the cylinder control valves have burst, presumably due to the shock pressures encountered. Preliminary tests at the laboratory using a hydrauliscope indicate that shock pressures as high as 5000 psi are likely to be encountered, but that these will be dissipated by the cylinder relief valves returning the excess fluid to the reservoir. As yet we have not been able to ascertain the exact cause of the cylinder control valve failures. This type failure has not occurred in the prototype AVLB launcher located at these laboratories. We suspect that the cylinder relief valves may not be operating due to malfunctioning, or that the relief pressures are set too high. Other possibilities include defective valve castings and fatigue failure of the valve casting.

Corrective action to date includes a requirement for the cylinder control valve to be rated safely for 3500 psi working pressures and to withstand a 7000 psi proof pressure. We would like to include a requirement for the cylinder control valve to withstand a specified minimum number of impulse fatigue cycles of shock loadings; however we lack sufficient background data to arrive at a value which can be met by industry. Any information or discussion of this problem would be appreciated.

SEYMOUR WENGROVITZ
Chief, Bridge Section
Applications Engineering Branch
Civil Engineering Department
U. S. Army Engineer Research and Development Laboratories
Fort Belvoir, Virginia

• *What features do you want in the ideal fluid reservoir? Can you get the features you need? What complaints do you have about present reservoirs?*

My ideal fluid reservoir would have the following features: 1) Occupy minimum floor space. 2) Easy access to filler, sight gage, drain, cleanout covers, strainers. 3) Manifold for all piping connections. 4) Terminal box for motor and valves. 5) Mounting surface for valve manifolds.

I can only get about half the above mentioned features in commercial fluid reservoirs. The big-

Continued on page 24

Circle 71 →

Air operates this folding machine to provide the neatly folded, factory-fresh shirts found in popular shirt stores. In the background, left, is an air- and steam-operated pressing machine that furnishes smoothly pressed shirts in seconds.

Compact 25S2 distributes air through 2-inch air-mains and laterals to individual machines. Mr. Hopper, (at right), expects "many years of trouble-free service from the Model 25S2 compressor."

Van Heusen "cuts operator fatigue–

ups output per machine by 10% to 20%" with a

LE ROI 25-HP STATIONARY COMPRESSOR

Shirt-making is exacting work. It's so tiring that an operator's output can drop 40% in five hours. To reduce fatigue and to maintain efficiency, "we prefer air control for the more delicate operations of sewing and trimming machines, laundry, pressing and creasing work," reports Charles G. Hopper, assistant to the production manager of the Pottsville (Pa.) plant of Phillips-Van Heusen Corp.

At least some of the credit for reducing fatigue and increasing production is given to the 25 horsepower Le Roi compressor which provides air-power in their shirt factory.

The 105 cfm, 125 psi capacity of the Le Roi 25S2 air-cooled compressor more than meets current needs, and provides for the addition of more air-operated machines. Mr. Hopper states that the unit operates 10 hours a day, five and one-half days a week. To assure dependable air supply, valves of the 25S2 are inspected weekly, and oil is changed every 200 hours.

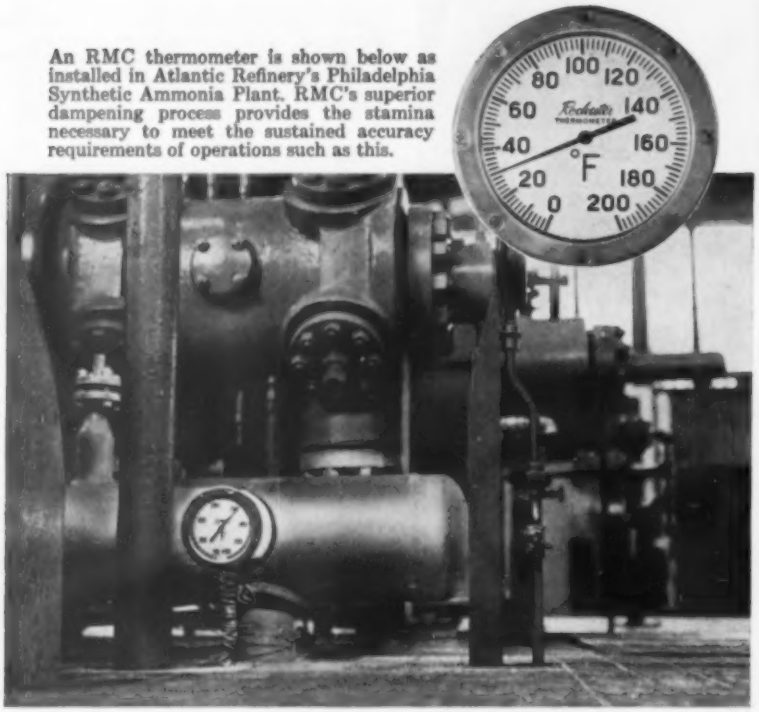
Why don't you check the benefits of pneumatic operation? Le Roi can meet your needs with Westinghouse unit-type and Le Roi stationary air compressors from ½ to 100 hp. See your Le Roi distributor for more information. Or write to Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin.

LE ROI STATIONARY COMPRESSORS

SC-09

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

An RMC thermometer is shown below as installed in Atlantic Refinery's Philadelphia Synthetic Ammonia Plant. RMC's superior dampening process provides the stamina necessary to meet the sustained accuracy requirements of operations such as this.



RMC dampening process insures sustained thermometer accuracy

RMC dial thermometers are thoroughly dampened with silicone on the bimetal element and a special precision-machined bearing on the shaft. The combined use of this dampening bearing *and* silicone makes RMC thermometers extra resistant to shock and vibration.

Facts you should know about proper dampening of bimetal thermometers

It is generally assumed that bimetal dial thermometers are dampened merely to prevent pointer oscillation when used on vibrating equipment. True, the prevention of pointer oscillation is necessary, but there are more important reasons for the use of dampening.

The primary reason is to preserve accurate calibration, especially in the lower temperature ranges where a thinner bimetal element is used. An *un*dampened bimetal element, when subjected to shock or severe vibration, would have a tendency to unwind slightly and throw the instrument out of calibration.

To prevent this, RMC thermometers are dampened by a patented process in which the bimetal element is coated with silicone. The silicone provides permanent protection for the critical bimetal element, holding the coil in place and preventing any unwinding or shifting action—thus helping to maintain calibration accuracy.

But RMC goes one step beyond silicone, with a specially designed bearing which even further dampens both shaft and coil. The bearing also serves as a better guide for the bimetal shaft to keep it perfectly aligned within the tube. Only RMC uses this extra dampening device in addition to silicone and the usual guide bearings.

It is the combined use of the special dampening bearing *and* silicone that makes RMC thermometers extra resistant to shock and vibration. You get this *only* in RMC industrial thermometers.

Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC., Rochester, N. Y.

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FORUM

gest complaint has to do with inadequate piping connections, requiring a complicated mass of fittings.

J. COHEN
The Cross Company
Detroit 5, Mich.

I would like to see these features: leakproof, accessible for filling and draining, good vent arrangement to atmosphere, and standardized fittings.

S. ENFIELD
Phoenix Cement Co.
Clarkdale, Ariz.

• *Are you using straight-thread tube and hose fittings? Do these seal with an O-ring or a metal-to-metal fit? What are the advantages you've gotten with them? If you are not using them now, are you planning to in the future?*

In our present pneumatic system we are using AN fittings at operating pressures of 5000 psig. The line sizes are ¼" and ⅜" stainless steel tubing. The metal-to-metal fits have been holding up very well on six test stands that we use in our lab.

Our company manufactures ball valves and we have to adapt to various types of fittings. These are short tests and not often used. But for one of our customers we have supplied both AN and MS fittings on the pneumatic actuator we supply with some of our valves. Our customer would farm the valve out to a testing lab for production environmental vibration tests. Out of 38 valves, the fittings developed leaks on approximately 50%. This problem never was resolved by us and finally taken out of our hands and controlled by the customer.

At present we are looking for high pressure fittings that can be used at pneumatic pressures of 10,000 psig with a factor of safety of 4. Any information available would be appreciated.

B. SCHLATTERER
Engineer
Hydromatics Inc.
Livingston, N. J.

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DENISON HydrOILics

This AUTOMATIC truck handles hefty steel coil like a baby with smoother, safer DENISON hydraulic power

FLUID POWER

HYDRAULIC HANDLING *for steel coil. This "Skylift Giant" unit was developed by Automatic Transportation Co., Chicago—Division of Yale & Towne Mfg. Co. The "Coil Up-Ending Attachment" is powered by Denison Axial Piston hydraulic pumps.*

FLUID POWER for this "Skylift Giant" industrial truck—equipped with a special "Coil Up-Ending Attachment"—means it can easily heft rolls of coiled steel weighing from 10 to 40 tons. *Denison hydraulic power pays off here in smoother, faster, safer handling.*

In leading mills, these heavy-duty trucks speed handling and storage without damaging coils. The Coil Up-Ending Attachment enters the coil's inside diameter with a fixed ram . . . while the outside is gripped by a powerful hydraulic clamp. This clamp-and-ram design prevents "telescoping" of coils during handling.

Three hydraulic cylinders—powered by motor-driven Denison 3,000 psi Axial Piston Pumps—furnish lifting and clamping power. All three cylinders are connected hydraulically in parallel, which results in a telescopic-cylinder action—but has the added advantage of retaining equal force and speed throughout the stroke at constant pressure and delivery.

Result: Operator easily controls lowering speed at any level . . . and can inch the load up from extremely slow speed to maximum for which the flow control is set. *Safe, fast, smooth hydraulic control helps keep "Skylift" trucks continuously on-the-job . . . handling extra payloads.*

Here's the kind of job your Denison Hydraulic Specialist can help *you* do *now*. Call him in. See how Denison hydraulic power can help put *more payload into your equipment.*

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

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PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC POWER

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All Sizes and Quantities of Viton, Butyl, Teflon and Silicone Now in Stock.

A tremendous inventory of all Military Spec as well as standard quality "O" Rings is now carried by Bearings, Inc. in order that we may be able to meet all customer requirements without delay.

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Reusable and Swaged-On Assemblies!

COMPLETE LINE OF SURGEPRUF COUPLINGS AND HYDRAULIC HOSE

Only Surgepruf Reusable Couplings and Hose Have These Outstanding Features:

Superior Fluid Seal eliminates seepage between coupling shell and wire braid • Non-Skive Assembly provides fastest field assembly with just ordinary tools • Superior Finish—precision-machined steel couplings have zinc dichromate finish to pass rigid salt-spray tests • Full Interchangeability—regardless of hose line, Surgepruf couplings are available in any style and thread.

Now from one reliable source... a full range of Swaged-on Assemblies and Shurlock Reusable Couplings, Hydraulic Hose... and Adapters!

Get superior performance . . . dependable operation with the expanded Surgepruf line. From low pressure to high pressure hydraulic applications, Surgepruf new design and quality features provide the rugged and dependable service you *need* for *all* equipment . . . plus fast, easy on-the-job replacements!

Contact your Wholesale Supplier—or write for the following Surgepruf catalogs: No. 40-25, Reusable Coupling and Hose Catalog; No. 40-37, Swaged-on Hose Assemblies Catalog; No. 40-36, Adapters Catalog. Dept. 524, 1850 Diversey Parkway, Chicago 14, Illinois.

Symbol of SW Excellence

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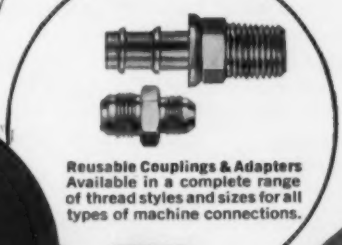
STEWART-WARNER CORPORATION
1850 Diversey Parkway, Chicago 14, Illinois

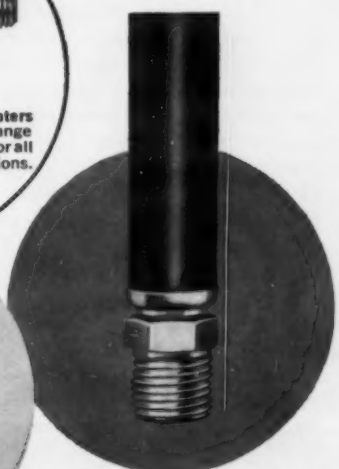


Reusable Couplings & Adapters Available in a complete range of thread styles and sizes for all types of machine connections.

High Pressure Hose. Burst and working pressure equivalent to SAE 100R2. In hose ID's from ¼" to 2".

Medium High Pressure Hose. Burst and working pressure equivalent to SAE 100R1. In hose ID's from ⅜" to 1¼".

Medium Pressure Hose. Complies with SAE 100R3 requirements. In hose ID's from ¼" to 1".

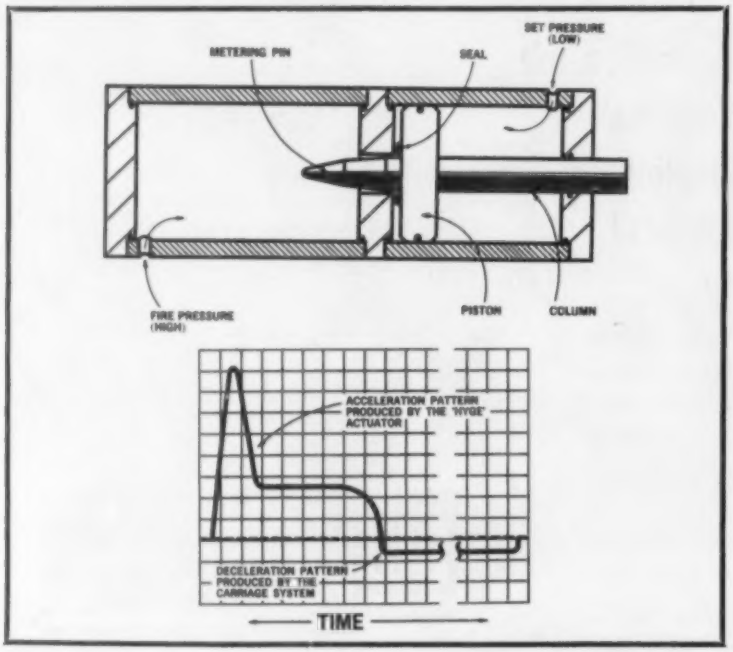


Low Pressure Hose. Burst pressure, 1000 psi.; working pressure, 250 psi. In hose ID's from ¼" to ¾".

BRIEFS

about fluid power

Pneumatics Tests Water-Entry Shock



By pressing a button, structure engineers simulate the impact of a missile nose cone plunging into the ocean at supersonic speeds. They can repeat with precision the tests on experimental components and structures. All water-entry test facilities use the Hyge principle developed by Convair Div., General Dynamics Corp. Convair's Dynapak Facility, Pomona, put the principle into operation.

When a body hits the water, it abruptly decelerates. In the past, to duplicate the shock, devices hurled the test object against resilient materials. Since the deceleration forces must be absorbed by the test facility, the size and speed of test objects were limited, even if partial destruction of the test facility were acceptable.

The Hyge simulator creates g-forces by an extremely high, controlled acceleration. Since the test takes place during acceleration, deceleration can be stretched over a safe distance. Forces on the test equipment are then at a workable level.

The Hyge units use a piston and cylinder. Compressed air moves the piston. Air enters the cylinder through a narrow orifice. In the start position, the piston is against the orifice, sealing it. The fire pressure (low, to begin with) acts against the small, exposed area in the piston's center. The set pressure against the reverse side of the piston balances it. When fire pressure gets high enough, the piston moves slightly away from the orifice. Then fire pressure is against the entire face of the piston. Its force is many times the set-pressure force. In less than a hundredth of a second, the piston accelerates the test object to velocities of several hundred miles an hour, within inches of the starting point. Precise metering of flow through the orifice controls acceleration. Metering pins of different shapes and lengths provide different shock patterns.

The shape of water-entry shock waves is a sharp pulse as the object hits the water, then a gradual reduction in the deceleration forces.

The test object is mounted on a sliding carriage a short distance from the piston. On firing, the lightweight piston transmits a tremendous velocity to the object on impact. The energy input creates 100 g's acceleration in the carriage assembly. This shock lasts only until the piston's kinetic energy has been absorbed. Piston and carriage then move down the track together, accelerated by the air flowing through the orifice. Since only the test object is subjected to acceleration shock, the shock can't damage the test equipment. ▼▼▼

More Briefs on page 32

SWEEPSTER PICKUP BROOM for hydraulic loaders or fork lift trucks replaces loader bucket or clamps. It cleans a 5' path. It puts debris into a 6-cu-ft hopper, which can be raised for dumping into trucks. Quick-connect couplings connect the hydraulic pump to the hydraulic motor which rotates the broom. Rotation is toward the operator. It's made by Sweepster, Inc., Dexter, Mich.

Circle 57 ➔

ONE MAN ONE TRADE ONE TOOL

...your production line back in operation in

30 SECONDS

(if it's a Hunt PDQ Air Control Valve)

☑ **accessibility** ☑ **simplicity** ☑ **speed and capacity** ☑ **price and quality**

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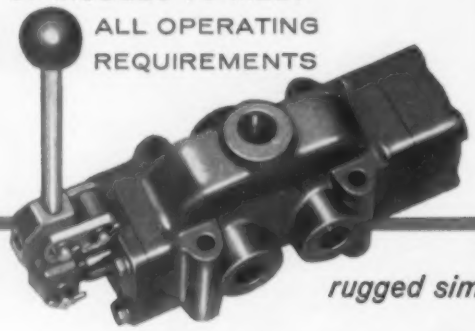
Quick-As-Wink AIR & HYDRAULIC CONTROL VALVES

ADEL...offers you *single source* responsibility

for precision hydraulic control valves

4-WAY SELECTOR VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING REQUIREMENTS



a complete line for every application

GENERAL SPECIFICATIONS

FLUID: Oil, for hydraulic use only.
PRESSURE: 1500 psi maximum.
FLOW: 3 to 28 gpm.
PORT SIZES: ¼ to 1" pipe size.
MATERIAL: Slides and spools—hardened steel; bodies—gray iron castings.
Various forms of return springs or detents for slide positioning.

MODELS

Lever-Operated For Hand Control. Stem-Operated For Remote Manual Control.

Solenoid-Operated in Various DC and AC Voltages.

Pilot-Operated For Remote Hydraulic Control.

rugged simplicity for efficient, long, reliable service life

These compact, 4-way selector valves are used for control of double acting, or single acting cylinders. Simple spool-type construction provides a wide variety of porting arrangements for either open-center or closed-center hydraulic systems.

The Valves With Maximum Operating Efficiency Over The Years
***Let ADEL be your* single-source *for* precision hydraulic equipment**
Write for valve brochure containing complete specifications.

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DISTRIBUTORS IN PRINCIPAL CITIES
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FLUID POWER SOCIETY
elects officers

CHICAGO—First directors' meeting of the newly formed Fluid Power Society was held in June to adopt a constitution and elect officers. The technical organzation has been formed to advance hydraulic and pneumatic technology, and to further the education of those working in this field. First president of the association will be Frank Mackin, chief of General Motors' Engineering Shops and a prominent figure in fluid power activities. He is also this year's associate director of NCIH.

Walter Ernst, author of the widely read book, *Oil Hydraulic Power and Its Industrial Applications,* was elected Vice President. He is vice president and director of engineering at Commonwealth Engineering Co. and a hydraulic consulting engineer. Allan Morris, editor of HYDRAULICS & PNEUMATICS will serve as the society's treasurer. Other members of the board of directors are Lynn Charlson, president of Char-Lynn Co., Barrett Rogers, executive vice-president of the National Fluid Power Association, who will serve the Society in the same capacity, and George Altland, supervisor of Vickers Inc. hydraulic school.

The first chapter of the Fluid Power Society will be installed in Detroit. A second group has been formed in Milwaukee. Plans are for one or more chapters in all principal cities of the U. S. and Canada by 1962. In addition to regular chapter meetings, a national meeting will be held annually to present technical and educational papers, and to coordinate projects of the Society. First national meeting is planned for October in Chicago.

FILL IN THIS APPLICATION FOR YOUR ADVANCEMENT IN HYDRAULICS AND PNEUMATICS.
Send it to the Society's address today.

FLUID POWER SOCIETY

5595 N. Hollywood Avenue, Milwaukee 17, Wisconsin, WO. 2-9950

I hereby apply for membership in the Fluid Power Society. If this application be duly approved, I agree to be governed by the Constitution and By-Laws of the Society, and to further its objectives as laid down therein.

1. Name _____
Last First Middle

2. Home Address _____
Street City Zone State

3. Name of Employer _____

4. Business Address _____

5. Nature of Business _____

6. Applicant's Title or Occupation _____

7. Address for Fluid Power Society Mail (check one) Home____ Business _____

Enclosed is my check for $10 which includes $5 membership application fee and $5 annual dues.

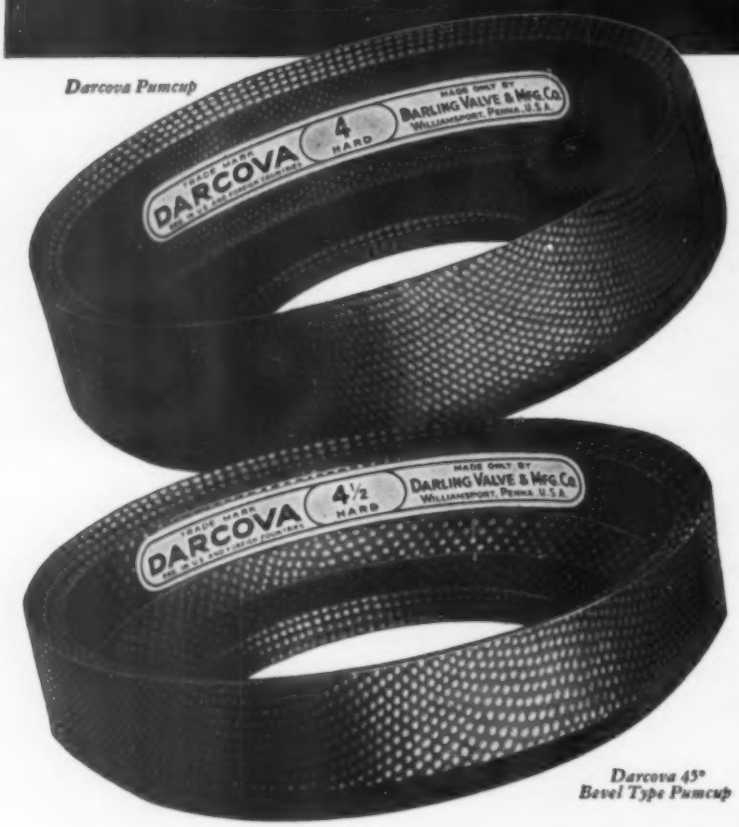
Date _____ **Signed** _____

DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS



Darcova Pumcup

Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5903.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA — THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

Circle **36** on Time-Saver Card

BRIEFS

NCIH Papers to Feature Cleanliness

CHICAGO—Theme of the 16th Annual Meeting of the National Conference on Industrial Hydraulics is *Design for Cleanliness in Fluid Power Systems*. Many of the papers scheduled for the two-day session will be about filtration, fluids, and sealing. During the first technical session on October 20, Howard K. Zintz, director of engineering, The Rucker Co., Oakland, will speak on "Hydraulic Filtration". The next day, H. L. Wheeler of Bendix Filter Div. will cover "Filtration in Aircraft Hydraulic Systems". "Recent Developments in Lip Seal Technology" will be given by R. L. Dega of General Motors Technical Center. R. Q. Sharpe's paper is entitled, "Why Ask for Surgically Clean Oils When Ambient Dirt is not Controlled". Sharpe manages the Industrial Technical Division of

Continued on page 36

INDUSTRIAL PUBLISHING ESTABLISHES STUDENT AWARD . . . Lester P. Aurbach, president of Industrial Publishing Corp. (publisher of HYDRAULICS & PNEUMATICS) hands $500 award to Thomas Ross, first winner of The Industrial Publishing Corporation Work/Scholarship Award. The annual award, established this year in recognition of the company's 30th anniversary, points up opportunities in the business press to young men with technical educations. It is open to juniors in engineering at M. I. T., Rensselaer, Ohio State, Case, Purdue, and Carnegie Tech. Winners get the cash award plus 10 weeks of summer employment on the editorial staff of an Industrial Publishing Corporation magazine.

Ross, an aeronautical engineering student from Indianapolis, was president of his Junior class at Purdue.

Circle **103** →

SKINNER *2-way and 3-way Solenoid Valves*

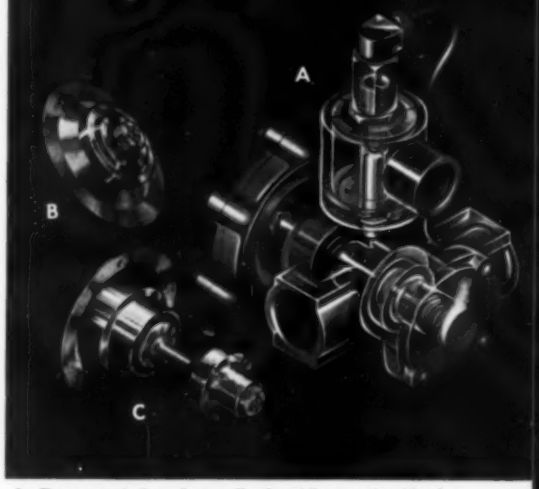
for high flow, heavy-duty industrial use

Skinner combines unique diaphragm assembly and V5 solenoid operator in new L Series valves

Skinner has now combined its famous V5 solenoid operator with a unique diaphragm assembly in a new line of two-way and three-way valves—the versatile L Series.

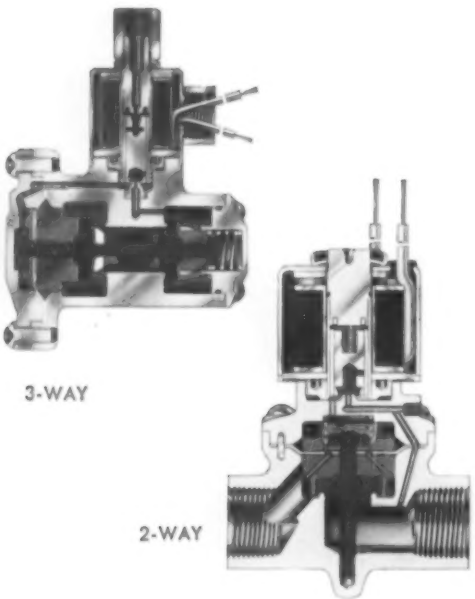
Unusually long life is assured by this new diaphragm assembly. The 3-way diaphragm consists of two tough laminates of nylon fabric coated with a Buna-N rubber separated by a thin Teflon disk. The assembly is virtually 100% supported in the open and closed positions with only a very small area exposed to pressure differential during operation. Life tests show that this type of diaphragm far out-performs all others tested.

The two-way diaphragm and spindle assembly supports a seal retainer and soft, synthetic seal which provides bubbletight sealing of the main orifice. This seal fits on a shoulder which extends beyond the seat and helps to cushion the closing motion—thus minimizing water-hammer.



A—Transparent view of normally closed 3-way solenoid valve
B—Front view of diaphragm assembly
C—Spindle seal retainer and diaphragm assembly

Low cost 2-way and 3-way valves to meet your high flow industrial requirements



Cutaway views of 2-way and 3-way valves showing how the unique diaphragm assembly and solenoid operator are combined in these new valves.

Skinner L Series solenoid valves feature forged naval brass bodies, stainless steel and brass internal parts. They are available normally closed, normally open and directional control in standard and explosion-proof construction.

In addition to the many exclusive features, these Skinner valves are low in price, and with one model—a 2-way normally closed valve—available at especially low budget cost.

All 3-way and 2-way normally open valves are supplied with a piped exhaust return. For catalogs and complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

SKINNER L SERIES SPECIFICATIONS

	TWO-WAY	THREE-WAY
Pipe Sizes, NPTF	⅛"*, ½", ¾", 1"	⅛", ½", ¾"
Orifice Sizes	½", ¾", 1"	⅛", ½", ¾"
Operating Pressure Differential — Minimum	5 PSI	5 PSI (⅛" 10 PSI)
Operating Pressure Differential — Maximum	150 PSI	150 PSI
Position	Normally closed, Normally open	Normally closed, Normally open, Directional control
Leakage	Bubbletight	Bubbletight
Temperature Range (Ambient and Media)	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F

*has ½" orifice

When you specify solenoid valves, specify Skinner.

Skinner solenoid valves are distributed nationally.

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION,
THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

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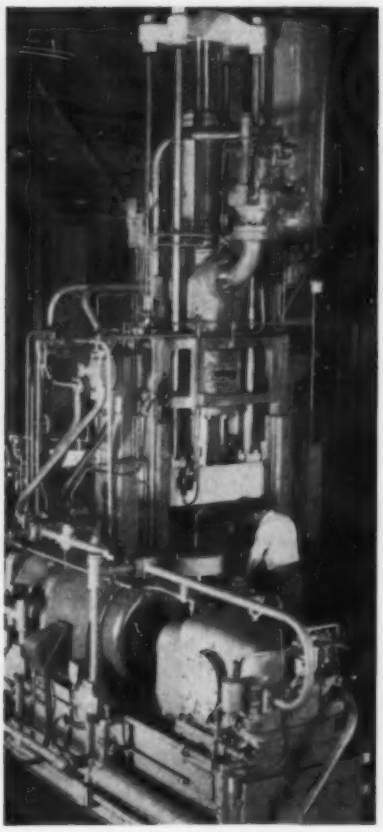

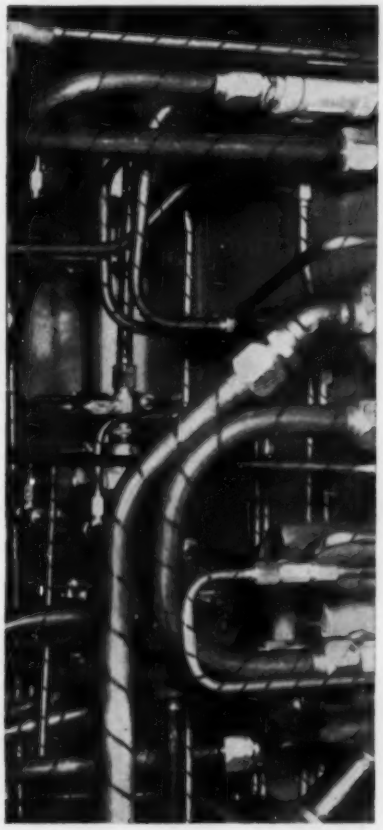

FOR HIGH PERFORMANCE... SPECIFY ELECTRUNITE HYDRAULIC FLUID LINE TUBING—SPECIAL SMOOTH I.D. CYLINDER TUBING

Tube users with critical tubing requirements specify Republic ELECTRUNITE. Because, the consistent uniformity of concentricity of ELECTRUNITE welded steel tubing makes this tubing better able to withstand stubborn resistance to fatigue.

The uniform concentricity of ELECTRUNITE Hydraulic Fluid Line Tubing, produced to meet all test requirements of the JIC Standards, coupled with uniform heat treatment, insures uniform flaring characteristics, uniform ductility, easy bending. Big savings in original and in replacement installations. And, you can recognize ELECTRUNITE by the blue spiral marking stenciled end-to-end on every length.

ELECTRUNITE Special Smooth I. D. Hydraulic Cylinder Tubing, in sizes from 1" through 4½", and up to .187 wall thickness, reduces costly, time-consuming machining because uniformity is built-in. Uniform wall thickness, strength, diameter, ductility assures predictable, dependable, physical characteristics with every order.

Get the facts first-hand. Call your Republic representative. Or, send the convenient coupon below.

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☐ ELECTRUNITE Special Smooth I. D. Hydraulic Cylinder Tubing

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Firm _____
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City _____ Zone ____ State _____

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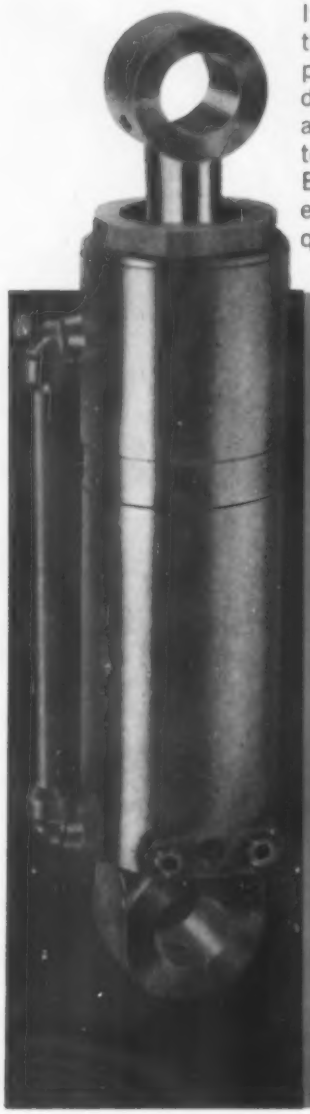
HYDRAULIC CYLINDERS FOR TOP ON-THE-JOB RESULTS



If you insist upon top performance on-the-job, then always demand B-H-E-W products. Only B-H-E-W offers basic designs and trained specialists to adapt these quality design techniques to suit your specific application. With B-H-E-W working for you, production economies, production efficiency and quality products are your end results!

THIS IS B-H-E-W's "DUAL PILOT" CHECK VALVE. It insures positive piston rod lock in any position when the directional control valve is in neutral. You know the rod will not drift. This simplifies hydraulic line circuitry, eliminates separate pilot operated check valves, connections and lines. Your on-the-job efficiency is highly improved when you use B-H-E-W Hydraulic Cylinders!

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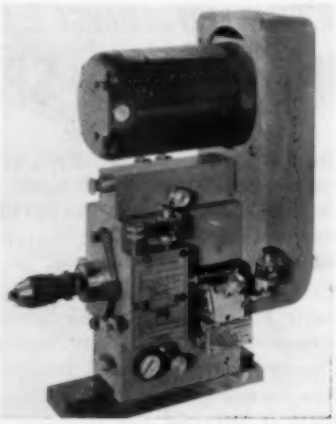
Socony Mobil's Products Dept. R. O. Isenbarger, Chicago Rawhide's chief engineer, will speak on "Sealing Devices for Exclusion of Foreign Material from Hydraulic Mechanisms".

Hydraulic and pneumatic servomechanisms will be described. Moog's H. B. Kolm and Ken Garnjoft will present "Electrohydraulic Servo Application with Mechanical Feedback". John Harned and J. Robertson, Jr., senior research engineers with General Motors Research Laboratory, will give "Pneumatic Servo Steering".

For more information about the Conference contact William Smith, NCIH secretary, Illinois Institute of Technology, Chicago 16. ▼▼▼

1-Spindle Unit is Versatile

Universal-Automatic Corp., Schiller Park, Ill., has introduced an automatic unit which drills, taps, threads, reams, and does



other basic secondary jobs. It mounts at any angle and in any position. Speeds are from 500 to 10,000 rpm. Maximum spindle stroke of the self-contained unit is 2½", adjustable down to ⅛". Dovetail mounting permits 5½" major adjustment of head and 2½" of spindle stroke control. Capacity is .020" to ⅜" drilling and ⅜" tapping in mild steel.

Two double-acting air cylinders

Continued on page 38

Another pump problem . . . solved by **TUTHILL**

TUTHILL

pump-motor combinations add to precision, dependability of GPE electrohydraulic valve actuators

The Model 684 heavy-duty Electrohydraulic Valve Actuators produced by GPE Controls are used to position valves in response to low level DC input signals from electronic controllers, manual stations or flow or pressure transducers. Often used outdoors, they must be rugged . . . and their precision and dependability must be beyond question.

A vital component of these precision controllers is the Tuthill Series 48 close-coupled electric motor and hydraulic pump combination. Chosen primarily for their dependability, the compactness ($5\frac{7}{8}$"x$11\frac{15}{16}$"), and light weight (21 pounds) of these combinations enabled them to fit into GPE Controls' design without assembly difficulties.

Complete close-coupled selection

The Series 48 units are only one of a complete selection of Tuthill close-coupled combinations provided in three general series with capacities up to 50 gpm, for pressures to 500 psi. All units are particularly designed for applications where space is at a premium. Elimination of couplings, bases and adapters results in significant savings. Reduced weight means lower shipping costs . . . and their compactness simplifies assembly operations and lowers production costs.

Over 800 models

These close-coupled pump and motor units are but a small part of Tuthill's complete line of over 800 different standard models. In addition, Tuthill's experienced staff of application engineers will work with you in designing a special unit to precisely meet all the requirements of your particular application . . . "fit the pump to the problem."

Write today for Catalog 100 which describes the complete Tuthill line. Or, better yet, send drawings or other information on your pump application so that our engineers can indicate how Tuthill may be able to provide savings in your particular operation.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

AIR He N

COMPRESSION to

12,000 psi

...discharge capacities to 150 scfm

with

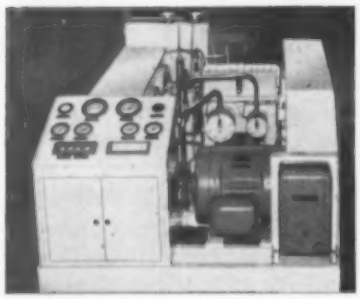
CARDAIR CENTRAL COMPRESSION SYSTEMS

New Technical Data and Catalog. See offer below.

Cardair Central Compression Systems (completely packaged, semi-portable)—are today handling air and a variety of gases—helium, nitrogen, argon, etc.—at pressures ranging from 4,000 to 12,000 psi with discharge capacities from 50 to 150 scfm. Even hydrogen is being safely compressed to elevated pressures.

Systems can be provided from stock with *guaranteed* purification of delivered gas to —100°F. dew point and less than 4 ppm oil content. Specially engineered systems to meet your particular requirements can be supplied from standard components.

This ability to control hard-to-handle gases, proven by years of exacting rocket and missile service, offers unlimited possibilities to industry—not only for testing and laboratory work, but also for actual production.



Model PB-CCS—*One of a wide selection of systems* 4-stage air-cooled Compression System—Pressure Range: 6,000—12,000 psig—Induction: 65 to 135 psig—Capacity: 75 scfm N_2 and Air; 70 scfm He—Guaranteed Gas Purity: —100°F. Dew Point, less than 4 ppm oil content.

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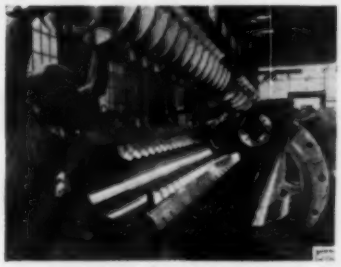
BRIEFS

advance and retract the spindle. The unit has air intake and exhaust-metering controls, air-pressure regulator and gage. It operates on 15 to 100 psi. The complete unit includes hydraulic feed control, adjustable top and bottom dwell, fixture-synchronizing stations, and positive depth control. ▼▼▼

Hydraulics Opens Continuous Mixer for Cleaning

The Ko-Kneader continuous mixing machine of Baker Perkins has a 16" cylindrical interior. Flights of the huge mixing screw rotate and reciprocate between the chamber's stainless steel teeth. The barrel is produced in halves. In assembly, it is bolted onto a hydraulically operated device and opened to accommodate the mixing screw. The device is part of the machine's system. It provides ready access for cleaning.



The machine weighs 21 tons. It processes 10,000 lb. an hour. ▼▼▼

Continued on page 40

BRIEF NOTES

NEW SEAMLESS METAL BELLOWS . . . for temperature and pressure-sensing devices operate at 1200 F, and at 12,000 psi. B. F. Goodrich Aviation Products' "Omega design" bellows withstand vibrations of 2000 cps. They are available in aluminum, inconel-X, monel, stainless steels, and beryllium copper.

BALL VALVE SALES FILM . . . has been produced for distributor education by Jamesbury Corp. The 20-minute, color-sound slide film treats the advantages of ball valve design. It shows more than 50 installations.

NEW LINE OF RAMS . . . and independent pumps have been introduced by Duff-Norton Co., Pittsburgh. The Ram-Pac line provides 10 to 100 lb. in any direction, for heavy moving, lifting, pushing, pulling, adjusting, testing, and bending. All rams can be used as permanent installations in hydraulic jigs, fixtures, or presses. Attachment units and accessories complete the line.

CLEAR RUST INHIBITOR . . . penetrates through corrosion and forms an air and moisture-tight seal. Poly-Rustex will not wash or wear away under normal conditions. It is low in viscosity, nonsettling, and nonfreezing. A gallon covers to 400 sq. ft. It comes ready-to-use. Manufacturer is Brad Chemical, Inc., Chicago.

BUSINESS BRIEFS

NARDA ACCUMULATOR BUSINESS BOUGHT . . . Hale Fire Pump Co., Conshohocken, Pa., will engineer, manufacture, test, and sell the line of accumulators formerly made by Narda Hydraulics Corp., Westbury, L. I. Other Hale products include fire, contractor, industrial, and irrigation pumps.

$3 MILLION EXPANSION FOR TUBING FIRM . . . Ohio Seamless Tube, div. Copperweld Steel Co., will double its tonnage capacity and put its welded and seamless steel tubing product lines into new markets. The Shelby, Ohio firm has scheduled two new electric weld tube mills for early 1961.

10% PRICE INCREASE . . . on all Ross Type CP heat exchangers was announced by American-Standard Industrial Div. Higher costs of materials and labor necessitated the increase.

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For Your Power Drive • Design • Application or Replacement Maintenance

There's a T-J CYLINDER

That Can Assure *Accurate Efficient Operation*

Only T-J's complete line can assure you a cylinder of either air or hydraulic application – with practically limitless design specifications for bore, stroke, pressure range and even delivery requirement. From the time-tested, standard tie-rod air and hydraulic, to the exclusive T-J Spacemaker, and including the recently introduced Squair Head, T-J cylinders give you more features for efficient, long-lasting operation. Write today!

Plus

THE ONLY COMPLETE ENGINEERING CATALOG LINE, TOO!

H-47 for standard tie-rod hydraulic cylinders.

SQ-1058-4 for the T-J Squair Head cylinder.

No. 64 for standard tie-rod air cylinders.

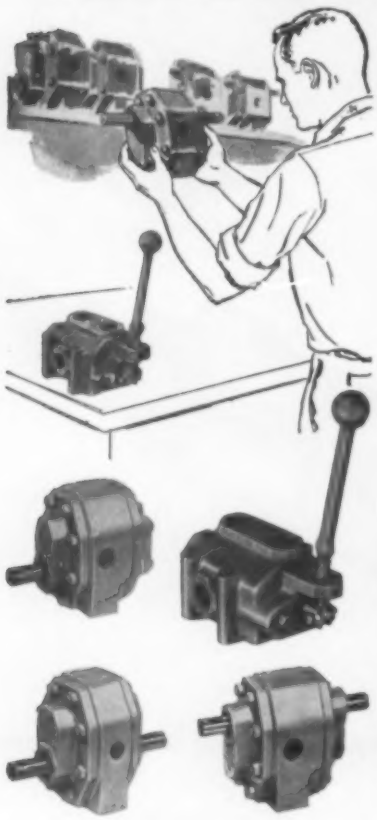
SM-56-3 for the incomparable Spacemaker cylinder.

HSM6-58-4 for the High-Pressure Hydraulic Spacemaker cylinder.

THE TOMKINS • JOHNSON CO. JACKSON, MICH.

CYLINDERS • MILLING CUTTERS • RIVETERS and CLINCHERS

"Off the Shelf"
HYDRAULIC EQUIPMENT



in capacities from 8 to 25 gallons... up to 1000-1500 psi

Engineered by the world's largest manufacturer of hydraulic jacks, Hein-Werner pumps, motors and valves offer compact, high precision, light weight, balanced design. *Valves offer*: large oil passages, close grained high tensile body castings, spring centered ball detent hold, pressure relief valve and hardened seat INSERT for long life. *Motors and Pumps* feature forced lubrication and internal bleeding for axial balance and to eliminate high pressures against oil seals; rotation in either direction, heavy duty roller bearings and gear type constant displacement.

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A DIVISION OF
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BRIEFS

Flick-Reedy Corp. Takes Two Awards

The Flick-Reedy Corp., Bensenville, Illinois, has won two national awards. Factory magazine named it one of the Top Ten Plants built in 1959.

Over 500 plants were nominated by U. S. architects and engineers, regional and state development commissions, railroads and utilities. Selection was based on adaptibility to changes in production methods and processes, provisions for growth and expansion, plant electrical services, services other than electrical, employee facilities and services, maintenance, and appearance.

ACCEPTING SILVER ANVIL AWARD for Flick-Reedy Corp. is its president, Frank Flick, right. Presenting are Stanley G. House, cochairman of Silver Anvil Awards, and H. Walton Cloke, president of American Public Relations Association.

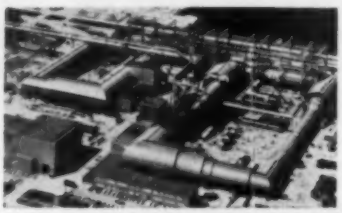
Flick-Reedy received from the American Public Relations Association a Silver Anvil award, in the manufacturers category. Anvils are presented for the execution of outstanding programs in the field of public relations. An award was presented in each of nineteen categories. ▼▼▼

USAF Windtunnel to Use F-R Fluid

A phosphate-ester hydraulic fluid will be used in the largest supersonic windtunnel in the Western World. Near completion at the USAF's Arnold Engineering Development Center, Tullahoma, Tenn., the tunnel will be 100′ long x 1½″-3″ thick. It will test aircraft, missiles, and their propulsion systems.

The fluid will actuate 116 ball screw jacks, which will flex the steel walls of the tunnel's nozzle section. Overall systems accuracy will be 0.035″.

The specification for the synthetic fluid was developed from



tests of servovalve internal leakage rates. The tunnel's unusual design features increased the need for a fire-resistant fluid. Simulated altitudes of 24 miles and wind velocities near mach 5 are anticipated. On the inside of the tunnel temperatures will reach 650 F; Around the hydraulic motors and servovalves, 550 F. Water tracer lines will keep fluid temperature low enough.

Swing joints connect all piping, to accommodate nozzle-actuator movement. But this flexibility might not prevent rupture of a hydraulic line.

Six 150-hp electric motors drive twelve 35-gpm pumps (3000 psi). Each of the 116 fliud motors and servovalves drives operates a jack.

Electric Boat Div., General Dynamics Corp., designed the hydraulic system. ▼▼▼

Fluid Power Group Meets in London

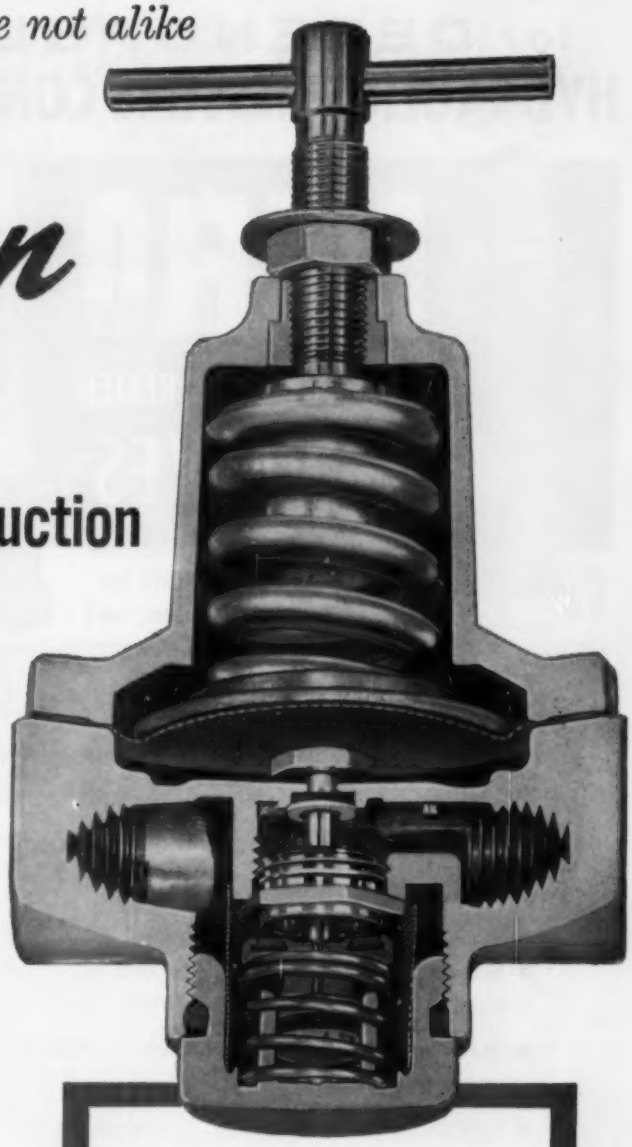
The 2nd European Fluid Power Conference was held in London recently, in conjunction with the Compressed Air & Hydraulics Exhibition.

The conference was divided into sections on hydraulics, pneumatics, and fluid power control. In the pneumatics section, P. L. Fonti of Italy outlined the increased productivity which compressed air has made possible in his country. He said that pneumatics' enormous potential should be vigorously publicized. A. A. Travers

Continued on page 42

All Pressure Regulators are not alike

Norgren



Balanced valve construction

The Norgren extra, assuring more uniform air pressure regulation

You buy an air pressure regulator for just one purpose: because you need accurately controlled pressure.

However, with any compressed air system, there are two operating conditions that, separately or together, can produce a change in the regulated pressure: 1. Fluctuations in line or supply pressure, and 2. Variations in air flow demand by your air-operated equipment.

That is why Norgren developed the balanced valve.
The balanced valve gives the Norgren Regulator an extra efficiency in compensating for changes in line pressure and changes in flow demand. As a result, the Norgren Pressure Regulator maintains the uniform delivery pressure you need, under any and all operating conditions.

Whatever your pressure regulation need, there is a Norgren Pressure Regulator designed for the job. Call your nearby Norgren Representative listed in you telephone directory—or WRITE FACTORY FOR DESCRIPTIVE LITERATURE.

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Norgren Pressure Regulators give you these important features:

Balanced Valve Construction—Improved regulator performance

Large Nylon-reinforced Buna N Synthetic Rubber Diaphragm—long service life

Baffle and Siphon Tube—Increased accuracy

Large Passages and Valve Openings—large flow capacity

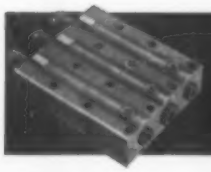
Easy servicing while still on air line

Flexible Valve Pin—assures better seating

for DEPENDABLE HYDRAULIC PRESSURE CONTROL

Low price and high quality make FULFLO piston-type hydraulic valves a natural O.E.M. choice. The service they deliver . . . quiet, dependable and trouble-free . . . makes them ideal from the equipment users' viewpoint.

- **Screw or flange models . . . to 500 lbs. . . . for pipe sizes to 3"**
- **Steel, cast iron or brass bodies . . . brass, steel or stainless trim**
- **Fast shipment of standards . . . specials to your requirements**



NEED A "Special"?
FULFLO can engineer a special valve to your most exacting requirements. Examples of "specials" are shown in Data Book.

FOR EXTRA CONTROL CONVENIENCE
Where frequent pressure setting is needed, install a FULFLO Hand Wheel Valve; available in a wide range of types.

Request complete catalog from:

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BRIEFS

pointed out how pneumatics can benefit small and middle-sized plants. He said that close liaison between purchaser and manufacturer is vital if the supplier is to provide the correct circuit at an economic price. F. X. Kay's paper on pneumatic circuitry reviewed the merits of hydraulic, pneumatic, and electrical techniques. He said that, far from being competitive, each has its own special applications. In his paper on the selection and maintenance of air compressors, W. R. MacMillan stated that it is always wiser to buy a unit larger than at first sight appears necessary, to allow for additions to the system. He recommended a margin from 25% to 30%.

ATMOSPHERIC PRESSURE HOLDS PORTABLE DRILLPRESS against surface being worked on. The Vacu-Press is mounted on a base which acts like a giant suction cup. There is a flexible neoprene seal around the edge of the base. The pump draws air from the base. The resulting 3000-lb. holding force will hold the unit against irregular or uneven surfaces. The press has enough stability for controlled drilling, and the convenience of portability. Manufacturer is Bux Magnetic Products, Inc., San Jose, Calif.

In the hydraulics section, Dr. W. Schlosser of Delft University, Holland, gave a technical paper on tests of positive-displacement pumps. E. I. Brown, Director of Engineering, Vickers, Inc., dealt with hydraulics in the United States. J. G. Smith, project engineer, Ford Motor Co. Ltd., Eng-

Continued on page 44

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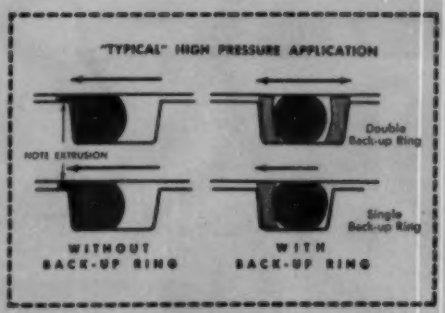
NOW – Increase O-Ring Life and Reduce Costs with...

Parbak*

The only contoured and continuous back-up ring... simplified, easy-to-assemble, resists higher pressures!

Here's the first really new back-up ring in years . . . Test after test, both in the field and laboratory, has proved that Parbaks* greatly increase O-ring life. In addition Parbaks* improve lubrication, are easy to assemble, and resist higher pressures — *yet they actually cost less* than back-up rings for similar useage!



Why not get the facts about these unique rings, now. Send for catalog 5482 – 8 pages of design data and other material about Parbaks.* It's free, of course.

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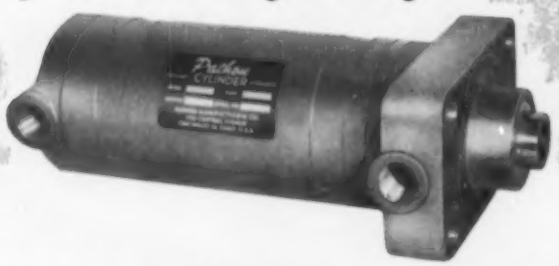
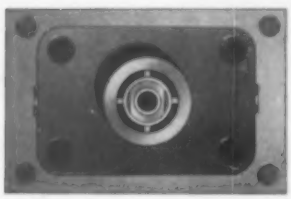
* Trade Mark

Pathon has Something *for Everybody*



Pathon Cylinders are designed to give you a highly practical cylinder that fits into almost every situation where a hydraulic cylinder is needed. Maintenance is at an absolute minimum because Pathon Cylinders are simple and easier to take apart and put together.

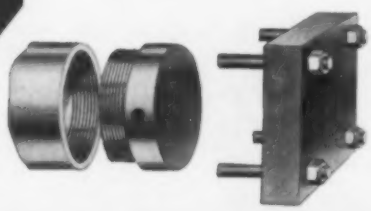


For the Designer

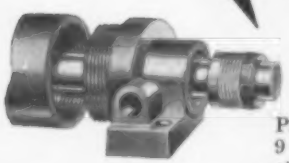
Pathon's compact design saves valuable space, makes your designing job easier, and gives your equipment added dependability with a modern rugged appearance.

For the User

Pathon's screw thread head design gives you up to 40% more strength than most tie-rod cylinders. This increased strength means less maintenance, longer life.



For the Maintenance Man



Rod packing and bearing is externally replaceable and any part can be replaced without complete disassembly and the resulting "basket full of parts."

Pathon Hydraulic Cylinders are available in 9 mounting types, thirteen bore sizes—1⅛", etc., through 14", and three Series—for 1000 PSI, and 2000 PSI and 3000 PSI.

Write for Bulletin No. 22-A

Pathon MANUFACTURING COMPANY

3823 PACIFIC AVE. • CINCINNATI 12, OHIO

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **91** on Time-Saver Card

BRIEFS

land, described hydraulics in automotive production lines. W. M. Morrison, technical director of Hydraulics & Pneumatics Ltd., England, covered industrial servos employing ball valves.

H. Masheder, James Gordon Valves Ltd., talked about trends in fluid power control. He emphasized the need for improved academic and technical educational facilities.

J. C. Wells, chief engineer of the Servo Division, Baldwin Industrial Controls, Ltd., discussed analog and digital electronic control, of fluid-power mechanisms. He said that hydraulic and electrical engineers should develop a closer understanding of each other's skills and limitations. ▼▼▼

"Where's that marine pump that came in for overhaul?"

Show to Feature Automation

Automation, Key to Manufacturing in the Sixties, will be the theme of most of the exhibits at the Production Engineering Show in September. The show will be twice as big as the one held five years ago. It will cover both sections of Chicago's Navy Pier. It will run concurrently with the Machine Tool Show at the International Amphitheater, September 6-16.

The shows are managed jointly —the same badge and registration fee will admit visitors to both shows. Hours are arranged so that visitors can see one show while the other is closed.

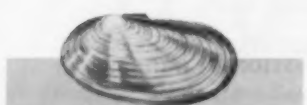
For more information, write Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. ▼▼▼

Wherever in the world your hydraulic machinery operates . . .

Shell Tellus Oil is there

Other outstanding Shell Industrial Lubricants available world-wide

- **Shell Rimula Oils**—for heavy-duty diesel engines
- **Shell Talona R Oil 40**—anti-wear crankcase oil for diesel locomotives
- **Shell Alvania Grease**—multi-purpose industrial grease
- **Shell Turbo Oils**—for utility, industrial and marine turbines
- **Shell Dromus Oils**—soluble cutting oils for high-production metalworking
- **Shell Macoma Oils**—for extreme pressure industrial gear lubrication
- **Shell Voluta Oils**—for high-speed quenching with maximum stability



AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Cultellus** costatus.

Around the world, Shell Tellus Oil is available—under the same brand name and providing the same performance that your domestic customers rely upon.

Tellus® Oil is top-rated as both a lubricant and control fluid for complex hydraulic systems. Its ability to combat oxidation, rust, sludge formation, wear and foaming has earned it world-wide popularity.

No matter where your hydraulic machinery is shipped, make Shell Tellus Oil your standard recommendation. Write for complete information.

SHELL OIL COMPANY

50 WEST 50TH STREET . . . . . NEW YORK 20, N. Y.
100 BUSH STREET . . . . . SAN FRANCISCO 6, CALIFORNIA
IN CANADA: SHELL OIL COMPANY OF CANADA, LIMITED
505 UNIVERSITY AVENUE . . . . . TORONTO 2, ONTARIO

SHELL

Circle **102** on Time-Saver Card

ANNOUNCING

SHATTER-GUARD

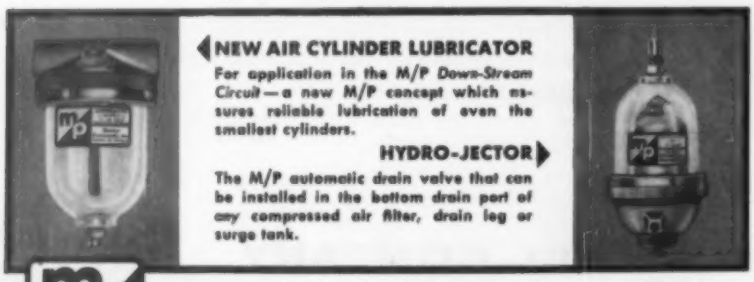
A safety feature now standard on M/P Filters and Lubricators

- Eliminates the "burst" hazard
- Contains all fragments and parts including drain cock when burst occurs
- Resists damage by impact
- Retains visibility advantage

Any transparent filter or lubricator bowl used in a compressed air system may be weakened by *impact, heat* or *chemical attack*. The eventual burst frequently scatters parts and fragments violently.

To eliminate this hazard M/P now supplies the *Shatter-Guard* as a standard part of every *Visi-Bowl* unit. *Only M/P transparent bowls are as safe as metal bowls.*

A brochure outlining bowl-breakage causes and describing M/P Field Conversion Kits is available. Consult your local representative or M/P for complete information.



NEW AIR CYLINDER LUBRICATOR

For application in the M/P *Down-Stream Circuit*—a new M/P concept which assures reliable lubrication of even the smallest cylinders.

HYDRO-JECTOR

The M/P automatic drain valve that can be installed in the bottom drain port of any compressed air filter, drain leg or surge tank.

MASTER PNEUMATIC, INC.

20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

Circle **79** on Time-Saver Card

FUTURE EVENTS

MACHINE TOOL EXPOSITION & MEETING
September 6-16
International Amphitheatre
Chicago, Illinois

PRODUCTION ENGINEERING SHOW
September 6-16
Navy Pier
Chicago, Illinois

ASME JOINT AUTOMATIC CONTROL CONFERENCE
September 7-9
Massachusetts Institute of Technology
Cambridge, Mass.

2ND COLISEUM MACHINERY SHOW
September 7-15
Chicago Coliseum

ASME RUBBER & PLASTICS CONFERENCE
October 9-12
Lawrence Hotel
Erie, Pa.

SAE A-6 COMMITTEE MEETING
(Aircraft & Missile Hydraulic & Pneumatic Systems & Equipment)
Week of October 17
San Francisco, Calif.

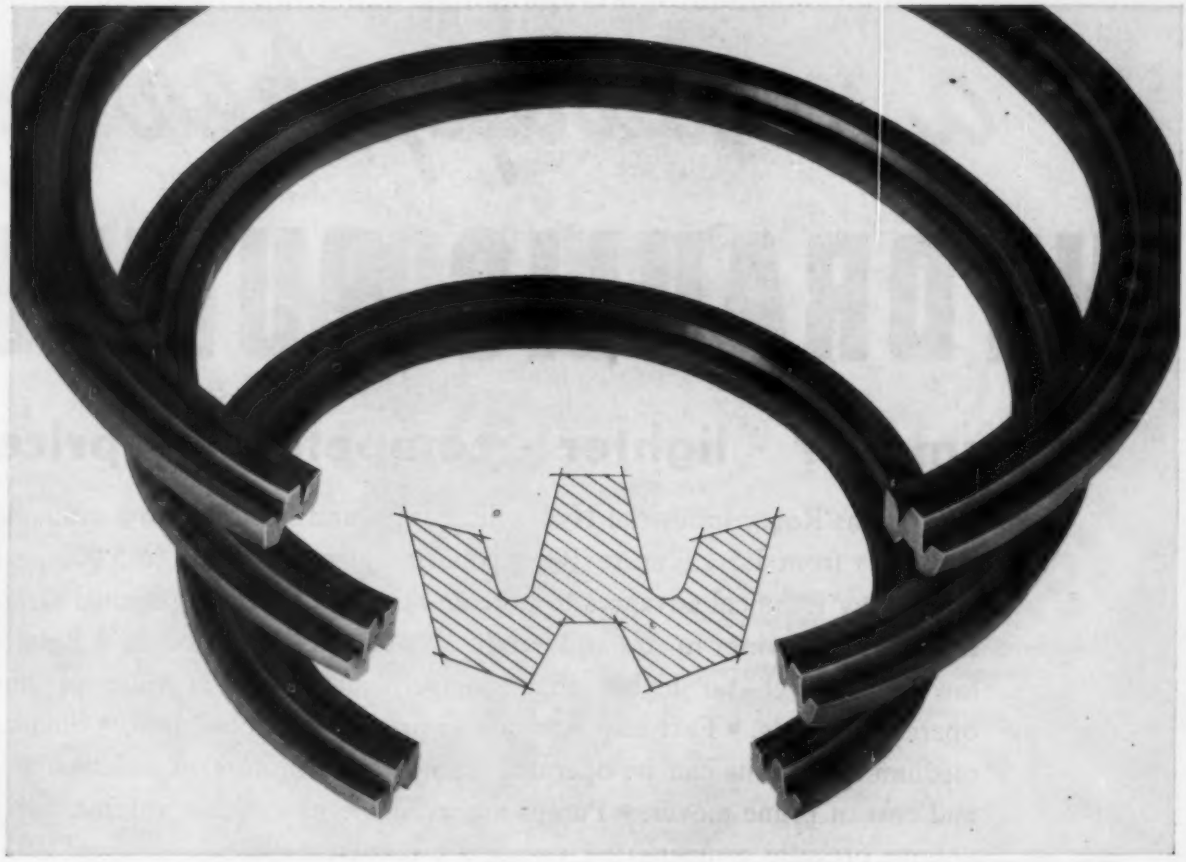
ASME-ASLE LUBRICATION CONFERENCE
October 17-19
Statler Hilton Hotel
Boston, Mass.

16TH NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS
October 20-21
Sherman Hotel
Chicago, Illinois
For additional information, contact William Smith, Illinois Institute of Technology, Chicago 16, Illinois

NATIONAL FLUID POWER ASSOCIATION FALL MEETING
October 31-November 2
Edgewater Beach Hotel
Chicago, Illinois

1ST NATIONAL DIE CASTING EXPOSITION & CONGRESS
November 8-11
Detroit Artillery Armory

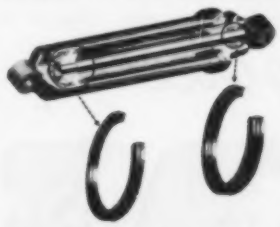
ASTME WESTERN TOOL SHOW
November 14-18
Los Angeles Memorial Sports Arena



Efficient sealing made to your measure... by JOHNS-MANVILLE

For equipment that requires other than standard packing styles, dimensions or materials . . . J-M offers made-to-your-measure custom moulded packings.

3-YEAR PERFORMANCE TESTS PROVE LONG LIFE AND EFFICIENCY OF J-M UNEEPAC



For 3 years, a J-M customer gave Uneepac "the works." Uneepac Rod Packings got a 350,000-cycle test; Uneepac Piston Rings a 150,000-cycle test. Both provided a perfect seal for 3 years . . . proved able to stand working pressures to 2,500 psi and shock pressures to 4,000 psi!

These packings are exactly engineered to measure up to your service conditions. J-M will select the materials that most economically handle temperature or other conditions. J-M will also recommend the specific design and construction needed, taking into account pressures . . . motions . . . and all other factors found within the equipment.

More and more manufacturers and those concerned with preventive maintenance now specify from J-M's broad selection of standard moulded automatic packings . . . or call on J-M's custom service. Either packing, whether standard or custom-made, is designed to give you optimum economy per packings dollar.

Here are some of the reasons why. Each pressure-actuated ring is an efficient, individual seal, interlocks with adjacent rings without compression adjustment. J-M packings are quick and easy to install. They are self-centering . . . self-adjusting . . . and offer interesting design possibilities. With J-M UNEEPAC®, for example, you can design smaller piston and rod stuffing boxes, and still get efficient sealing even in minimum packing depth.

Immediate shipment of all standard J-M packings. And complete information on J-M's entire line . . . plus specific recommendations for various applications and service conditions . . . is in free booklets PK-126 A and PK-148 A. See your J-M Distributor. Or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

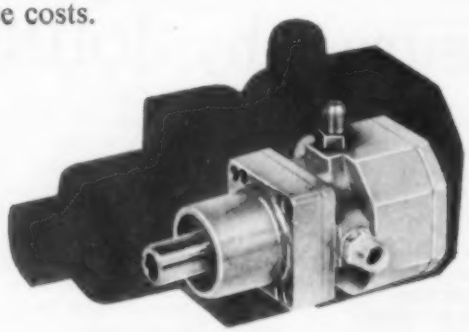
JOHNS-MANVILLE JM PRODUCTS

a new supplier of

HYDRAULIC PUMPS

smaller · lighter · competitively priced

New Lucas-Rotax Industrial Hydraulic Pumps and Motors—now available in capacities from 1.5 g.p.m. to 108 g.p.m. and at pressures up to 5,000 p.s.i.—offer many technical advances to potential users. • Small in physical size, for considerable savings in size and weight over conventional models. • Relatively low noise level—no higher than competitive makes—in spite of higher operating speeds. • Fast response rate in pressure compensation. • Small and medium sized units can be operated from 2 pole motors to reduce the size and cost of prime mover. • Pumps are available as variable volume, variable volume pressure compensated, overcentre cam (reversible), or as fixed volume, as required. • Motors can be supplied in variable or fixed volume, as required. • Both pumps and motors are designed to deliver high efficiency performance with low maintenance costs.



Size of Lucas-Rotax Type IA4 Pump is shown in relation to size of competitive unit of comparable rating.

a product of creative engineering by

LUCAS-

For further information contact U.S. Representatives:
JULIUS KENDALL,
Kenett Corporation
320 Washington Street,
Brookline 47, Mass.
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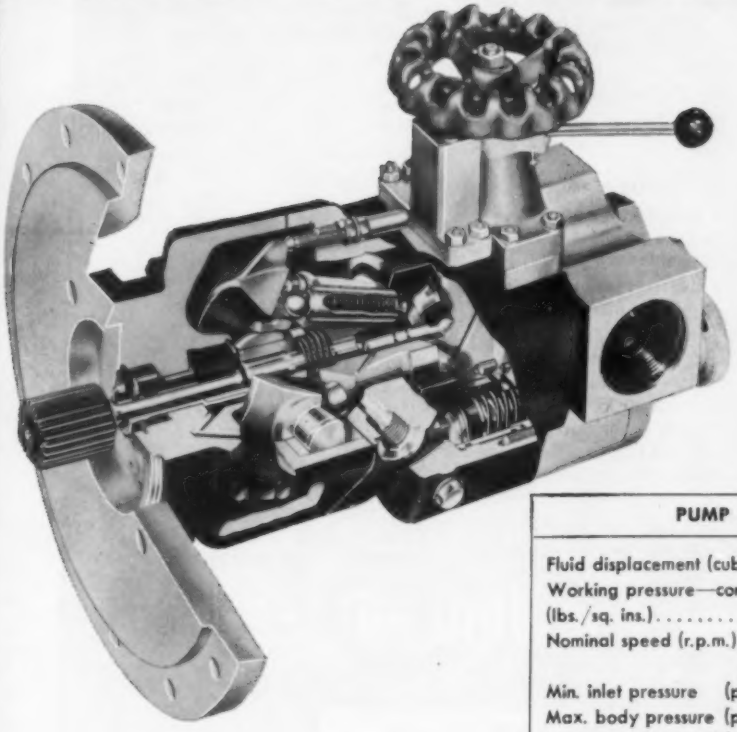
industrial

AND MOTORS



Lucas-Rotax Type IA 38-9 is a nine piston pump, variable volume, pressure compensated, designed for application on Ground Support Equipment.

PUMP DETAIL	BASIC UNIT
Fluid displacement (cub. ins./rev.)	2.43
Working pressure—continuous	5000 @ 15 g.p.m.
(lbs./sq. ins.)	3000 @ 30 g.p.m.
Nominal speed (r.p.m.) peak	4000
—continuous	3750
Min. inlet pressure (p.s.i.g.)	10
Max. body pressure (p.s.i.g.)	200
Compensation speed (seconds)	.045
Operating Temperature (°F)	250 to —40
Weight (less A.N.D. flange)	37 lbs.
Direction of rotation (viewed on shaft)	C/Clockwise

Models are available from domestic stock in capacities from 1.5 g.p.m. to 108 g.p.m., capable of pressures up to 5,000 p.s.i. Write for technical literature, or contact the agent or office nearest you for further information.

ROTAX
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USEFUL LITERATURE

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Cylinders

Air & hydraulic cylinders have 1½" to 8" bores. Mountings are foot, flange (rod end), swivel, flange (blind end), trunnion, clevis, and bracket. One-piece piston gives 3-point surface bearing. Hard chrome cylinder bore and rod. High-tensile-steel tie rods are stress-proof. Cushion adjusting screw. Solid steel heads and mounting plates. Chevron-type self-adjusting rod packing gives maximum seal, minimum friction. Piloted packing gland assures absolute alignment. Metallic rod wiper. Bulletin SQ-3-60 lists bore sizes, dimensions, and allowable strokes. 16 pages. *Tomkins-Johnson Co., Jackson, Michigan.*

Circle **400** on Time-Saver Card

O-Rings & Back-Up Rings

O-rings of Teflon, Nylon, and Kel-F in all AN and MS sizes and configurations to 39" OD. O-rings of hollow stainless steel, pressurized and nonpressurized. Available coated with Teflon. Teflon spiral and single-turn back-up rings. Raw materials offered. Envelope-sized folder lists general properties of Teflon and Kel-F. Describes other Teflon applications. *Tetrafluor, Inc., Inglewood, Calif.*

Circle **401** on Time-Saver Card

Wire-Cloth Filters

Elements are of stainless-steel, convoluted wire. For differential pressures to 10,000 psi at 5-micron nominal filtration. Standard inline filters for 3000-psi operating pressure, 450-F operating temperature. Filtration is 5, 10, 20, 30, 40 microns. Aluminum cases. Port sizes from ¼" to 1" tube. Based on MIL-0-5606 at 70 F and 10 microns, differential pressure from 13 to 9.6 psi at 1.25 to 25.00 gpm. On same basis, T-type filters have differentials from 18 to 10 psi at 1.2 to 25.0 gpm. Filters to 1800 F available. 4-page folder has drawings, specification charts, graph of pressure drop vs. flow. *Skinner Filter Div., Hydrodyne Corp., North Hollywood, Calif.*

Circle **402** on Time-Saver Card

Air & Gas Compressors

Type 30 reciprocating compressor is single-acting, air-cooled. Single and multi-stage. ½ to 20 hp. For pressures from vacuum to 5000 psig. Capacities to 170 cfm. Tank or baseplate-mounted, or bare. With or without electric motor or gasoline engine. Type 40 is stationary, single-acting, 2-stage. Air-cooled cylinders and intercooler. 25 to 125 hp. 80-125 psi. Requires no foundation. Direct-connected, V-belted, or flexibly coupled drive. ESH and ESV are stationary, double-acting, single-stage. 21 sizes

from 20 to 150 hp. For pressures to 150 psi. Multi-stage ESH units for 2500 psi. Air-cushioned channel valves. Full floating aluminum bearings. Filtered, force-feed lubrication. Completely sealed crankcase. V-belt drive. PRE heavy-duty, duplex compressor is horizontal, direct-connected. Synchronous motor drives it. Single and 2-stage. From 400 to 2000 hp. Pressures from 5 to 125 psi. Form 223 also shows axial flow pumps, and air tools. Photos, descriptions, and bulletin references. 8 pages. *Ingersoll-Rand Co., New York, N. Y.*

Circle **403** on Time-Saver Card

Pumping Units

Rated to 2000 psi. To 49.2 gpm of 200 SSU oil at 1200 rpm, 1000 psi. To 60.5 gpm at 1800 rpm. Pump is flange mounted directly to end bell of electric motor. Adjustable relief valve. Reservoir has screened filler-breather, liquid level sight gage, and return fittings. 100-mesh monel screen suction strainer. *Paul-Munroe Hydraulics, Bell Gardens, Calif.*

Circle **404** on Time-Saver Card

Fittings

Flared and flareless tube fittings. Straight thread flared and flareless tube fittings. Pipe and hose fittings. Materials include steel, brass, aluminum alloy, and stainless steel. Drawing, parts numbers, and dimensions for each type. Catalog 1-20A shows complete line, including plugs, unions, connectors, nuts, caps, elbows, tees, crosses, reducers, nipples, and bushings. 70 pages. *Afco Fitting Co., Cleveland, Ohio.*

Circle **405** on Time-Saver Card

Corrosion Resistance Chart

Lists over 150 chemicals and their recommended usage with ductile iron, iron, steel, 316 and 304 stainless steel, monel, brass, bronze, copper, aluminum, and plastisol plastic. Shows proper gasket materials for quick-couplers, proper O-ring materials for swivel joints. Chart J-CRC. 4 pages. *OPW-Jordan, Cincinnati, Ohio.*

Circle **406** on Time-Saver Card

Pulse Switch

Adjustable pulse switch 1PD1 is for momentary opening and closing of circuit. To change pulse length, turn pulse-adjusting screw on side of switch housing. Depress operating plunger for entire pulse

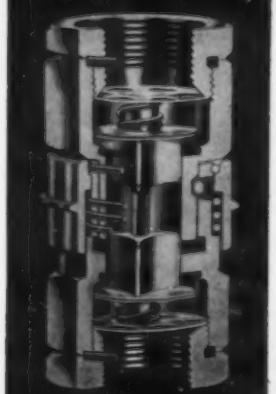
Continued on page 52

Snap-Tite *valved* couplings stop flow instantly"

Snap-Tite provides instant shut-off wherever fluid coupling is needed.

Snap-Tite *valved* couplings connect and disconnect quickly and fully—they automatically open line flow when connected; positively seal your line when disconnected—with no "ifs," no chance for human error.

Snap-Tite couplings are available in sizes from ¼" to 6" ID, in steel, brass, aluminum, 303 ss and 316 ss. Sizes from 6" to 10" ID are available on special order. For more information, write for Snap-Tite catalog #58. Snap-Tite representatives are located in all principal cities.



Provided with valves to give two-way or one-way automatic line shut off.

Built to handle high pressure hydraulic and pneumatic systems

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

Snap-tite

ST-59-05

UNION CITY, PA.

Circle **104** on Time-Saver Card

jamesbury

"Double-Seal" Ball Valves

STYLE "H" SERIES HIGH PRESSURE

3000 TO 4500 P. S. I.

"Double-Seal" BALL VALVES

- Pressure range: high vacuum to high pressure
- Virtually leakproof and indestructible in service
- Temperature range:—320°F to +400°F*
- Eight sizes ¼" through 2"—available in both pipe and tubing threads
- On-Off service, quarter-time, full flow construction

. . . a unique, compact, single-piece body of rugged design which permits wide high-pressure, high-vacuum applications, especially recommended for hydraulic equipment and the handling of compressed gases or hazardous fluids. Cryogenic (low temperature) uses are also feasible with extended bonnet adaptation. Available in Straight Tubing or Standard Pipe Thread as catalog items. Flanged valves available on special order.

¼ In. — ½ In.	¾ In. — 2 In.
4500 PSI (—20°F to +160°F)	3000 PSI (—20°F to +160°F)

Jamesbury Style "H" Double-Seal Ball Valves are available in Carbon Steel, 303 and 316 Stainless Steel.

"TEFLON", Special Nylon or synthetic rubber seats and seals.

*Selection of valve seats and seals determine the temperature and pressure ratings.

Write for Materials and Pressure Specification Sheets for Style "H" series for performance data.

JAMESBURY CORP., 72 NEW STREET, WORCESTER, MASS.

264-0

Distributors in Principal Cities

Circle **65** on Time-Saver Card

USEFUL LITERATURE

operation. Oiltight switch has spdt circuit. Electrical ratings are 10 amp, 125, 250, or 480 vac; ½ amp, 125 vdc; and ¼ amp, 250 vdc. Data sheet 173 has photos and drawings. Describes characteristics. *Micro Switch, Div. Minneapolis-Honeywell Regulator Co., Freeport, Illinois.*

Circle **407** on Time-Saver Card

Axial Piston Pumps

For continuous service to 5000 psi. Constant and variable-volume pumps to 115 gpm. Fluid motors to 373 in-lb per 100 psi. Series 30, 40, and 60 available in packages with built-in replenishing pump for supercharging. Pressure control and forced circulation for cooling. Relief and replenishing valves. Pressure compensator, handwheel, rotary and linear servos, and horsepower limiters. Bulletin 203 has performance charts for pumps and motors. Schematics and text explain axial piston pumps. 8 pages. *Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio.*

Circle **408** on Time-Saver Card

Piston Rod Boots

Sleeves, boots, way protectors, and machinery covers. Round, square, rectangular, and all combinations. Protect piston rods, cylinders, and entire drives. Chloroprene-coated nylon materials meet MIL-C-20696. Withstand —60 to 220 F without cracking. Bulletin SPC-3. *A & A Mfg. Co., Inc., Milwaukee, Wis.*

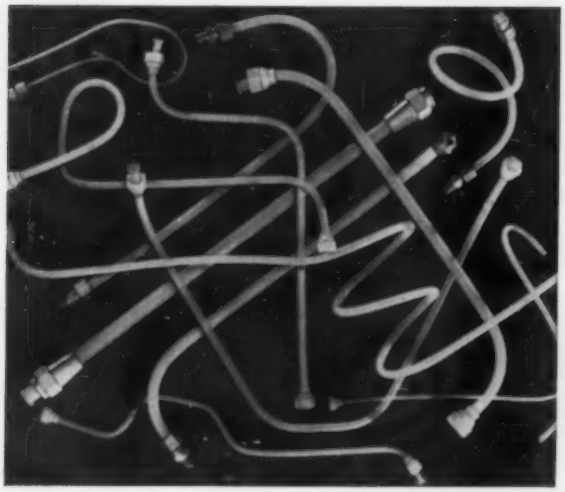
Circle **409** on Time-Saver Card

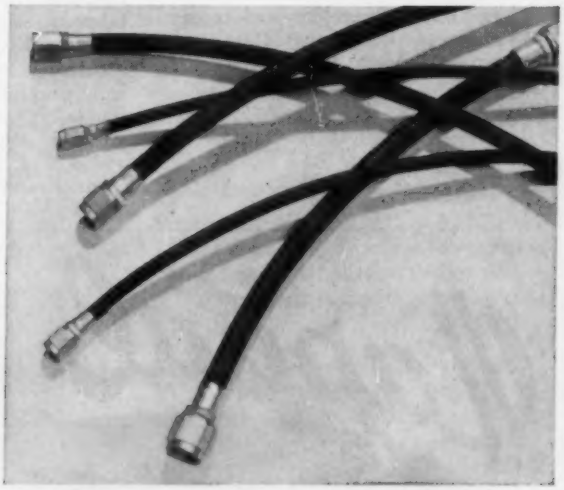
Automation Components & Control Systems

Timing components and linear measuring systems for industrial and military users. Condensed Catalog D-31 covers electronic timers, special timers, package control systems, military components and systems, test equipment, switches, controllers, contactors, valves, differential transformers, motion transmitters, edge guide, pressure transmitters, demodulators, indicators, recorders, control relays, servomechanisms, amplifiers, servo

Continued on page 54

NOW GET BOTH FROM ONE DEPENDABLE SOURCE!





NYLAFLOW®

Pressure Hose and Tubing

NYLAFLOW Flexible Pressure Hose—a new, all-synthetic polyamide tube reinforced with high tensile yarn and abrasion resistant cover*—or NYLAFLOW Pressure Tubing! Both are now available from the same dependable source.

New NYLAFLOW Pressure Hose weighs only 1/5 as much as rubber of equivalent burst strength . . . and has exceptional resistance to flex and vibrational fatigue.

Unaffected by flammable and non-flammable hydraulic fluids, hydrazine and other rocket fuels, with excellent resistance to caustics and most organic solvents. Freon permeability is approximately 1/10 that of rubber hose. Excellent non-conductor for use around high voltage lines.

Odorless, non-toxic, non-corrosive, fungus resistant and will not embrittle in storage. Temperature range (−65°F. to +250°F.). Form stable and can be permanently heat-formed to small, stress-free bend radii.

Burst pressure ratings of 5000 and 8000 psi.; available in long continuous lengths in standard diameters up to ½". Compact, light-weight, reusable fittings and assemblies also available.

NYLAFLOW Pressure Tubing in sizes up to ⅜" O.D., with burst pressure ratings of 1000 and 2500 psi., is ideal for lower pressure requirements. It is flexible for easy installation and can be attached with standard flare or compression fittings designed for metallic tubing.

*Patents applied for

Full details and illustrated brochures now available on new NYLAFLOW Pressure Hose and NYLAFLOW Pressure Tubing. Write today!

POLYPENCO

INDUSTRIAL PLASTICS

The Polymer Corporation of Pennsylvania

Reading, Pa.

USEFUL LITERATURE

kits, transformer kits and aero transducer kits. Information on proximity switch, hydraulic servo-valve, set point transmitters, and zero adjusts. 30 pages. *Automatic Timing & Controls, King of Prussia, Pa.*

Circle **410** on Time-Saver Card

Sequence Programmer

Minimatic sequencing programer MSP-1 is for precise timing and cycling of automated machinery or semi-automatic work functions with air. Self-lubricating bearings. Eight one-piece cams on common shaft. Choice of cams. Mounting bracket accommodates eight cam followers, air valves, and small, snap-action electrical switches. Alignment holes in cams and end plates assure initial alignment of cams. Set screw in hub adjusts individual cams. Unit is 7⅞" x 4" x 3¾". ⅜" steel shaft is 9¼" long, cam extends at both ends. Can be driven by machine which it controls. *Clippard Instrument Laboratory, Cincinnati, Ohio.*

Circle **411** on Time-Saver Card

Air & Vacuum Pumps

Rotary positive air pressure and high vacuum pumps, gas boosters, and air motors. 2 and 4-vane types, single and double-cylinder, fan-cooled, water-cooled, air-cooled, oil-less, motor-driven, belt-driven, direct-coupled, automatically controlled, and integral pump and motor models. Catalog 460 gives construction details, dimensions, capacities, performance curves, and engineering and application data. Describes accessories. *Leiman Bros., Inc., Newark, N. J.*

Circle **412** on Time-Saver Card

Lubrication Booklet

Graphically illustrates cost-saving importance of a comprehensive lubrication program. Includes examples. Shows how program can be geared to the situation. *Mobil Oil Co., New York, N. Y.*

Circle **413** on Time-Saver Card

Rotary Gear Pumps

Bulletin explains theory of pumps. Three sample problems. Technical data section has charts and graphs of friction loss in rubber hose, friction loss in pipe, resistance of valves and fittings to fluid flow, single-acting cylinder displacement, and viscosity vs. temperature. Viscosity conversion table. Table of viscosities and specific gravity of common liquids. Conversion factors. Electrical data. Chart of materials for pumping various liquids. 36 pages. *Roper Hydraulics, Inc., Commerce, Georgia.*

Circle **414** on Time-Saver Card

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

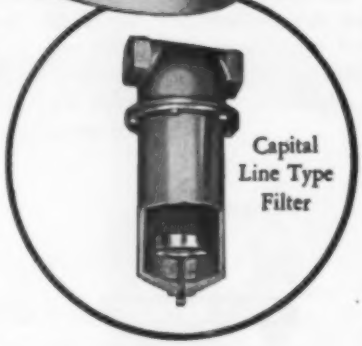
Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- MONO-BILT 60 Mesh All Stainless Steel (Sump type).
- MONO-BILT Standard All Stainless Steel
- MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.
- LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.



Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **27** on Time-Saver Card

For more reviews of FREE LITERATURE turn to page 121

MECHANICAL LEATHERS in Design Engineering

NATURALLY TOUGHER THAN OTHER MATERIALS

Garlock Mechanical Leathers—being of steerhide—have an unmatched tensile strength and toughness. Also, leather packings have a low coefficient of friction, minimum cold flow. They provide extremely good resistance to abrasion and wear . . . actually tend to polish metal surfaces which they contact!

Garlock leather packings can be impregnated for a variety of hydraulic applications. For example, they can be made soft and flexible for low pressures; semi-rigid for intermediate pressures; firm for high pressures.

Cold and hot water, oils, air, gas, oxygen, alcohol, glycerine, gasoline, kerosene, and other non-caustic fluids will not harm leather packings. They can be used in temperatures from sub-zero to +200° F. Garlock leather packings are suitable for pressures from a few ounces to many thousands of pounds per square inch.

In any of three leathers—BITAN*, Chrome, or Oak—Garlock can furnish all shapes, sizes, materials and designs of leather packings for hydraulic use. They're made in a modern packing plant which maintains highest standards of quality. Molded Cups, "U" Packings, "V" Packings, Washers, Gaskets, Discs, Flange or Hat Packings are some of the more commonly specified types. Sizes range from 1/8" O.D. leather washers for needle valves to 99" O.D. "U" Packings for heavy duty hydraulic service.

Contact your Garlock representative at the nearest of our 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-121,

GARLOCK

Garlock Inc., Palmyra, New York.

Canadian Div.: Garlock of Canada Ltd.

Plastics Division: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different types of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products

*Registered Trademark

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

CARTRIDGE FILTER
. . . to be built in

Designation: Tell-Tale

Features: Fits into cavity of device such as a drillhead. Use in machine space which would otherwise go to waste. Use where appended filter would be impractical. Can have electric switch to give

remote signal of degree of clogging. Projecting part has dirt indicator and automatic bypass valve. Two screws mount filter. O-ring seals at mounting face and cover.

Specifications: Exposed portion of unit shown has 3⅝" dia, projects 2½". At 2-psi pressure drop with 150 SSU oil, requires 7"-deep cavity for flows from 6 gpm through 40-micron screen to 25 gpm through 238-micron screen. For greater flows, use deeper cavity, longer filter element.

Rosaen Co.
Hazel Park, Michigan

Circle **300** on Time-Saver Card

PILOT RELIEF VALVE
. . . no spool hunting

Designation: POR-75A & POR-75B

Features: Accurate repeatability. Drilled crossholes in spool open and close gradually. Change from full closed to full open is stepless and smooth. Pilot flow passes through dampening orifice, smooths out pulsations caused by poppet relief. No abrupt motions. To get at adjusting screw, remove ¾" hex plug.

Specifications: Pressure inlet and return outlet are ¾". POR-75A is for 0-2000 psi; POR-75B, for 1000-3000 psi. Maximum capacity is 30 gpm.

Brand Hydraulics
Omaha, Nebraska

Circle **301** on Time-Saver Card

POWER PUMPS
. . . for high pressure

Designations: No. 797E-TA & No. 797VE-TA

Features: Radial pump. Eccentric shaft drives two, diametrically-opposed pistons. 4-way, spool-type control valve on top of pump controls high-pressure advance of ram and low-pressure return. Valve control handle is spring-centered, has 3 positions. Valve subplate has two ⅜" NPT outlet ports.

Specifications: When driven by 3-hp motor, 797E-TA delivers 213

cipm at 10,000 psi. 2-hp gives 106 cipm. 797VE-TA has auxiliary low-pressure pump on top of pump housing. Pump delivers 5 gpm to 800 psi. Unit has automatic change-over to 213 cipm at 4500 psi, 106 cipm at 10,000 psi.

Greenlee Tool Co.
Rockford, Illinois

Circle **302** on Time-Saver Card

HYDRAULIC HAND PUMP
. . . develops 8650 psi

Designation: No. Y28-A

Specifications: Oil capacity is 13.5 cu. in. Piston area is .110 sq. in.; diameter, ⅜"; stroke, 9/16". Displaces .0621 cu. in. Hose outlet is tapped ¼ NPT. Pump is 14 5/16" long.

Owatonna Tool Co.
Owatonna, Minn.

Circle **303** on Time-Saver Card

AIR DRYER
. . . prolongs tool life

Designation: Dri-Air

Features: Self-contained unit collects and automatically ejects water and oil from air lines. Collects dirt and rust.

Specifications: Units for 150 psi: DA50 for 50 cfm, ¾" lines; DA100 for 100 cfm, 1" lines; DA 300 for 300 cfm, 2" lines. HPDA units are for 300-psi lines. Have same capacities.

New Jersey Meter Co.
Plainfield, N. J.

Circle **304** on Time-Saver Card

PILOT RELIEF VALVE
. . . has low pressure rise

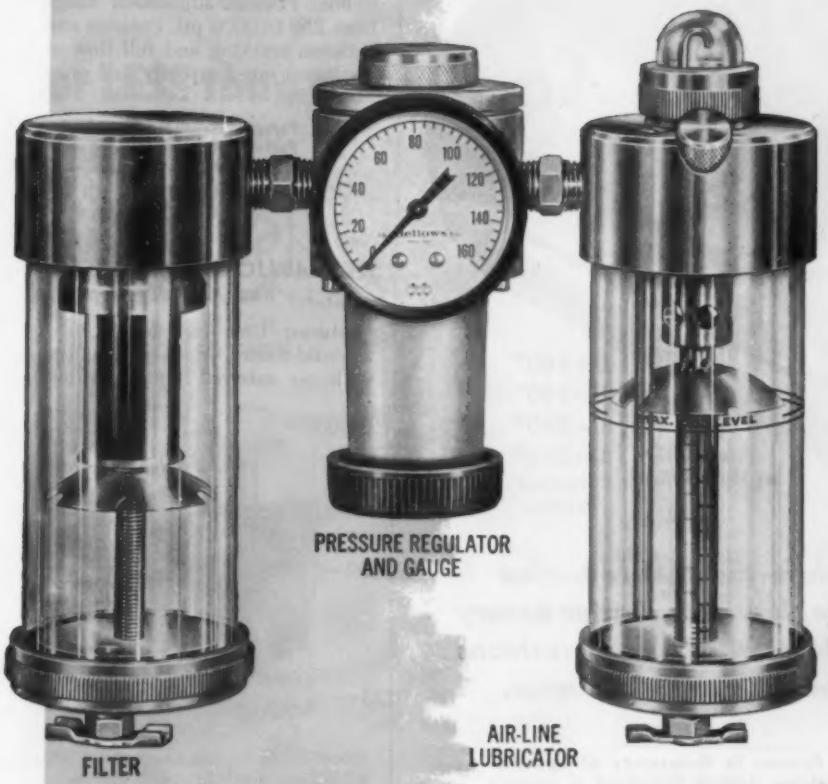
Designation: Hydrelief, model No. VPR3P3F

Features: For hydraulic systems in places where close maintenance is difficult.

Specifications: Capacity is 30 gpm mounted offset, 20 gpm mounted

Continued on page 58

AIR-POWERED EQUIPMENT



PERFORMS MORE EFFICIENTLY

COSTS LESS TO MAINTAIN

GIVES LONGER SERVICE LIFE

with a

Bellows LUBRI-AIR® CONTROL UNIT

HERE'S WHY: Once adjusted to the requirements of a particular air system, the Bellows Lubri-Air Control Unit automatically filters harmful dirt and moisture out of the air stream (40 micron filter element standard; 5, 10 and 20 micron units available) . . . automatically regulates air pressure by compensating for fluctuations in air supply and variation in cfm requirements of pneumatic equipment . . . automatically lubricates air-operated equipment by providing the correct amount of misted oil to the air stream. Bellows Lubri-Air Control Units are available in ¼", ⅜", ½", ¾" and 1" sizes.

Free Bulletin LA-15 gives complete information. Write for your copy today. Address Dept. AH-860. Bellows-Valvair, Akron 9, Ohio.

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, O., V. D. Anderson Co., Cleveland, Ohio.

675C-3

Bellows-Valvair

The Bellows Co. • Valvair Corp. Akron 9, Ohio

DIVISIONS OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

Now Rotary Torque Actuation, fully cushioned!

The
CARTER
ROTARY TORQUE ACTUATOR

Patents Pending

Pneumatic or Hydraulic

0—100°
0—190°
0—280°
0—370°
Standard Rotation

Explore the cost reduction you can get with safe, low-cost, Carter Rotary Torque Actuators—Now with built-in cushions for longer, more dependable performance.

- No by-pass leakage
- Built-in cushions
- Rotation to 370° as standard
- Positive locking, no back-off under tension or power failure
- Complete range of sizes

Proven in thousands of applications during the past 4 years!

The Carter Rotary Torque Actuator has opened unlimited new possibilities in design and cost reduction. Transfer mechanisms, indexing, positioning, cam actions, valve operation, and many other applications become more effective and economical.

Here is safe, powerful, Rotary Torque. Actuated by air, oil, water or gas. Patented seal assures leakproof performance. Internal helical design prevents back-off under reverse tension, shock, vibration or complete power failure.

Available in 4, 5, 6, 8, 10 and 12" diameters. Special sizes and rotation requirements are available. Ask your Carter representative or write for all the details!

Complete power package units available

SEND FOR NEW BULLETIN

Bulletin R.A. 500 gives complete details and specifications on the Carter Rotary Torque Actuators. Every engineer and designer should have a copy. Send for yours today!

CARTER
CONTROLS, INCORPORATED
2972 Bernice Road, Lansing, Ill.
Phone: Lansing—Glenville 6-3305 • Chicago—Skyport 1-7188

Circle **30** on Time-Saver Card

NEW PRODUCTS

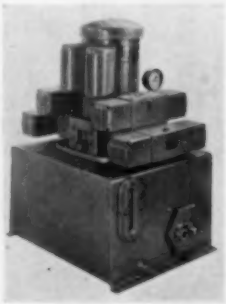
in-line. Pressure-adjustment range from 250 to 3000 psi. Pressure rise between cracking and full flow at maximum rated capacity and pressure is 6%.

Parker Hydraulics Div.
Parker-Hannifin Corp.
Cleveland, Ohio

Circle **305** on Time-Saver Card

HYDRAULIC POWER UNIT . . . has 10-gal reservoir

Features: Unit includes 1 to 4 solenoid-controlled, 4-way valves, with no external piping. Valves



mounted in series, allow automatic unoading. Built-in relief valves.

Specifications: 1, 1½, or 2-hp motors. 1, 1½, or 3-gpm pump capacities. Optional water/oil heat exchanger built into reservoir.

Double A Products Co.,
Sub. Brown & Sharpe Mfg. Co.
Manchester, Mich.

Circle **306** on Time-Saver Card

100,000-PSI TEST GAGE . . . has 1-piece tube

Features: Multicoiled tube is proportioned to minimize induced stress at critical points.

Specifications: Accuracy is .1 of 1% of full-scale reading throughout entire 270-deg. dial. Hysteresis not more than .1 of 1% of full-scale reading from top pressure. May be temperature-compensated to maintain full accuracy through ambient temperature variations to 100 F.

Heise Bourdon Tube Co., Inc.
Newtown, Conn.

Circle **307** on Time-Saver Card

Continued on page 60

NEW!

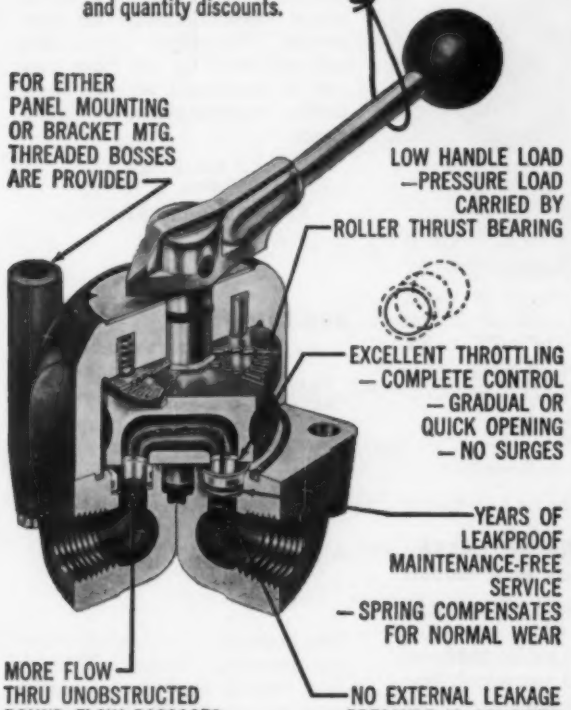
A "SHEAR-SEAL" VALVE

for LESS than a spool valve

RATED FOR 3000 P.S.I. OIL SYSTEMS

$65.00
List Price*
for a ¾" valve

*Less the usual O.E.M. and quantity discounts.


FOR EITHER PANEL MOUNTING OR BRACKET MTG. THREADED BOSSES ARE PROVIDED
LOW HANDLE LOAD —PRESSURE LOAD CARRIED BY ROLLER THRUST BEARING
EXCELLENT THROTTLING — COMPLETE CONTROL — GRADUAL OR QUICK OPENING — NO SURGES
YEARS OF LEAKPROOF MAINTENANCE-FREE SERVICE — SPRING COMPENSATES FOR NORMAL WEAR
MORE FLOW THRU UNOBSTRUCTED ROUND FLOW PASSAGES
NO EXTERNAL LEAKAGE — PRESSURE IS CONFINED TO FLOW PASSAGES

For complete data on this new valve and for information on all your valve requirements write for Catalog V-59-60

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **19** on Time-Saver Card

ONLY
This Pressure Switch Resists 7000 p.s.i. Surges and Stays Accurate within 2%

Adjustable Range: 15 to 3000 P.S.I.
Proof Pressures: 3000 and 7000 P.S.I.

$17.50 LIST PRICE*

*WITH CALIBRATED DIAL (can be set visually without gauges).
WITHOUT DIAL $16.50
Both prices less the usual quantity and trade discounts.

WE BUILD IN	WE DON'T USE
RUGGEDNESS CAN TAKE SURGES (High proof pressures) CONTINUOUS OPERATION (Millions of cycles) NO STICKING (in dirty fluid)	 LINKAGES & BEARINGS WHICH WEAR QUICKLY (cause settings to drift and switch to fail).
LABOR & MATERIAL SAVINGS NO RETURN DRAIN PIPING (Sealed piston) MOUNTS WHERE CONVENIENT (Operates in any position, not sensitive to vibration)	 UNSEALED PISTONS WHICH ADD TO YOUR INSTALLATION COST (return piping). ARE CRITICAL TO DIRT (pistons get stuck).

Send for FREE catalog 9-PS.

PRESSURE SWITCH DIVISION

Barksdale valves

5125 Alcoa Avenue, Los Angeles 58, California

Circle **20** on Time-Saver Card

it takes a . . .

"STRONG BENCH"

. . . to produce the

EXTRA QUALITY* *you get in* **PAUL-MUNROE**

HYDRAULIC PUMPING UNITS

Paul-Munroe pumping units are rugged and trouble-free. The EXTRA QUALITY of the components we use is your best guarantee of dependable service. For example, consider the following:*

*** (1) DOWTY**

HYDRAULIC PUMPS • Offered by Berry Hydraulics, this British designed pump has an exclusive journal bearing feature that provides extra-long life and unique wear compensating ability. Range to 3000 p.s.i. and to 60 g.p.m.

*** (2) REULAND**

ELECTRIC MOTORS • With Reuland's spline-coupled hydraulic pump mount motor, the pump shaft is connected directly to the motor's shaft inside the motor. This cuts space needs 50%, assures perfect alignment and provides smooth, quiet operation.

*** (3) PAUL-MUNROE**

MANUFACTURING • You get guaranteed performance when you specify Paul-Munroe pumping units. The hundreds of installations now in use provide the best demonstration of our expert craftsmanship.

To order or for additional information wire, write, or phone . . .

"CONTROLLED FLUID HORSEPOWER"

PAUL-MUNROE
HYDRAULICS

6430 East Gage Avenue, Bell Gardens, California
Telephone: Los Angeles SPruce 3-2870

Circle **92** on Time-Saver Card

NEW PRODUCTS

CYLINDER-OPERATED VALVES
. . . for air, oil or water

Designation: Shear-Seal

Features: In 4-way, 3-way, and shut-off. Cylinders cushioned or non-cushioned.

Specifications: For 3000, 6000, 10,000-psi hydraulic oil or water. For 2000, 4000, 10,000-psi air. Port sizes from ¼" to 1½" NPT. Cylinders for 500-psi oil or water, 80 to 250-psi air.

Berksdale Valves
Los Angeles, Calif.

Circle **308** on Time-Saver Card

CARTRIDGE INSERT VALVE
. . . in 4 models

Features: Fits inside pneumatic or hydraulic device which it controls. Fifteen of them can be combined into module, with one supply line,

one exhaust. Quick-opening. Positive dead-seal closing. Built-in quick-exhaust. May be used in heavy-duty service. Eliminates plumbing. Saves weight. Reduces assembly work. Speeds production. Simplifies design. Actuate manually, mechanically, electrically, or by pilot.

Specifications: ⅛" and ¼" sizes are 2-way or 3-way. For continuous cycling at speeds to 30,000 an hour.

Humphrey Products Div.
General Gas Light Co.
Kalamazoo, Mich.

Circle **309** on Time-Saver Card

CONDENSATE TRAP
. . . is electrical

Designation: ST-4C

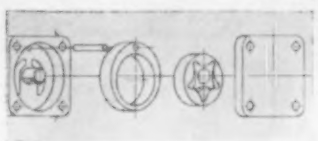
Features: For compressed air systems. Unit controls up to four solenoid valves in condensate lines. Replaces automatic traps for compressor intercoolers, aftercoolers, and receivers. For air filter traps and compressed air line blowdowns. Requires almost no maintenance.

Elvirso, Inc.
Buffalo, N. Y.

Circle **310** on Time-Saver Card

BUILT-IN PUMP
. . . eliminates mounting, couplings, connectors

Features: Build inner and outer geroter and eccentric locator ring



into housing of mechanism requiring pumping function. Throughbore casting or frame of mechanism to accommodate locator ring's OD. Provide porting. No mounting pads, couplings, connectors, or accessory drives.

Specifications: Handles fluids at rates to 100 gpm, pressures to 1000 psi.

W. H. Nichols Co.
Waltham, Mass.

Circle **311** on Time-Saver Card

For more NEW PRODUCT reviews turn to page 114

NATIONAL® OIL SEAL LOGBOOK

Presenting!

NATIONAL BUD UNITIZED

TRADE MARK

Flanges, if desired, are available to simplify positioning and removal

National BUD UNITIZED has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National BUD UNITIZED seals are now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer BUD UNITIZED seals are on the way for higher speed automotive and similar uses.

Changing a National BUD UNITIZED oil seal automatically changes the wear sleeve — in one fast, simple operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem — both thanks to the rubber surface BUD UNITIZED presents to the shaft.

For complete details or skilled engineering help on application of BUD UNITIZED seals, write direct, or call your National Seal Applications Engineer. You'll find him in the Yellow Pages, under Oil Seals.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

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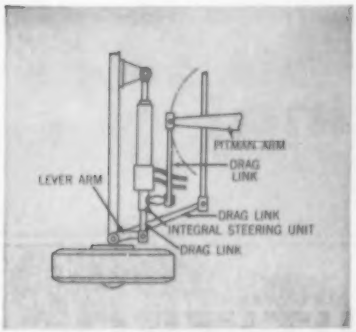
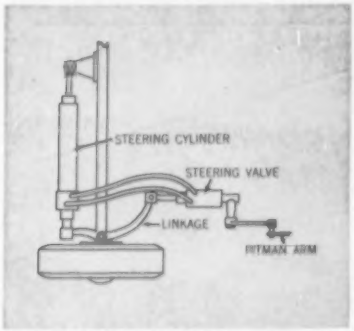
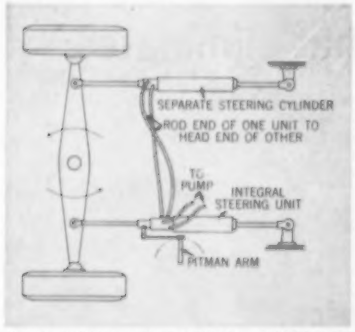


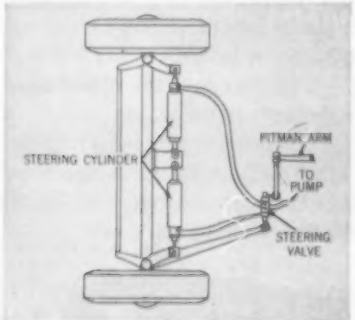
INTEGRAL LINKAGE system combines servo valve and steering cylinder with rod end fastened to frame and valve end to drag link.



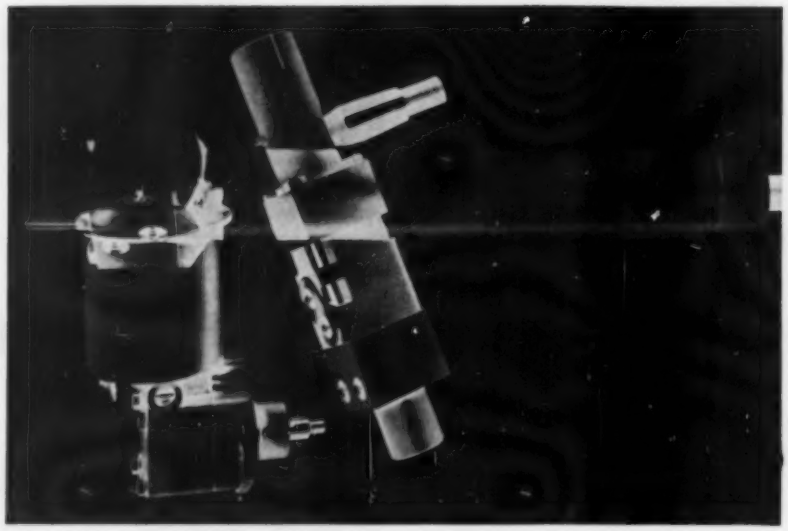
REMOTE LINKAGE system has separate servo valve and cylinder. Servo is mounted at most convenient point with cylinder located for maximum thrust.



COMBINED INTEGRAL-REMOTE system servo valve controls both cylinders. When integral unit (bottom) extends, remote unit (top) retracts.



REMOTE DUAL system uses one remote servo valve, offers best possible thrust conditions plus considerable installation flexibility.



FOR AXLE LOADINGS 1500—128,000 LBS.

New VICKERS power steering systems use standard units, offer custom performance

Performance benefits normally associated with custom designs plus the economy of standard, production-built components are combined in new Vickers power steering systems. The cylinder, servo valve, and pump—key elements in the power steering system—are always perfectly matched to system needs because Vickers builds the *complete system*.

Either remote or integral systems can be provided for the complete range of axle loadings from 1,500 to 128,000 lbs. All vehicles use the same servo valve—holding engineering and installation time to a minimum and reducing inventory requirements for manufacturers building several sizes or types of equipment.

Operating Economy—Systems are designed for high pressure operation (to 2000 psi) permitting smaller pumps, lines, reservoirs, valves and cylinders to be used. Further economy results because each basic size of steering unit is capable of a wide range of axle loadings. This permits some manufacturers to use a single size of steering unit for their complete line of vehicles. For example, in a single cylinder installation, the Model SC-26 cylinder can be used for any axle loading from 16,000 to 64,000 lbs.

Further economy over the life of the system results from the minimum number of moving parts required by this design and from its rugged construction. All cylinders are double walled to eliminate the common hazard of functional damage to cylinder walls from flying debris. Exclusive design vane pumps last longer, permit easy cold weather starting because pumping doesn't begin until after engine fires and comes up to speed.

Complete Responsibility – Both the equipment builder and ultimate user benefit because Vickers designs and builds all system components. In addition, a staff of power steering specialists is available to work with customers on specific development and application problems.

When equipment is being built for the export market, worldwide stocks and complete interchangeability of all parts made in Vickers plants throughout the free world offer added benefits.

More Data – Design advantages, dimensions, ratings, and other data are available in Bulletin titled "New Complete Power Steering Systems." Write for this 20 page Bulletin M5110.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION

Mobile Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

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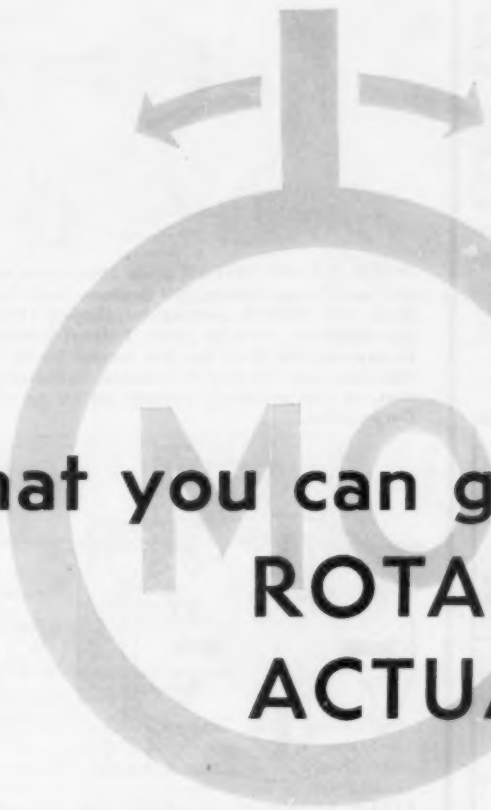
Hydraulics & Pneumatics
AUGUST 1960



What you can get in ROTARY ACTUATORS

• By JACK LOWERY, *Associate Editor*

A TOOL often overlooked by the hydraulic system designer is the rotary actuator. It is a device which rotates a shaft through a fixed arc, using a source of fluid under pressure to power it. The actuator's output torque varies directly with the fluid pressure applied to it. It can be used to clamp, feed, turn over, lift, transfer, or hold tension.

• **Actuator Designs**—There are three basic types of rotary actuators. One has one or more vanes attached to the drive shaft. The vanes are sealed in a cylindrical chamber and oscillate between stops integral with the casing. To rotate the actuator, a differential pressure is applied across the vanes.

Another type has a helix machined in the drive shaft meshing with a helix in a piston. As the piston moves back and forth, the shaft oscillates. Guide rods pass through holes in the piston to keep it from rotating.

The third actuator uses a rack, or racks rotating a pinion attached to the drive shaft. The racks connect to pistons which extend and retract to rotate the drive shaft back and forth.

• **Cushioning**—To decelerate the load at the end of its stroke, flow from the actuator must be gradually reduced. Some actuators have built in cushions that are either fixed or adjustable. Deceleration valves are also used to give external cushioning.

• **Speed Control**—Angular velocity is regulated by flow control valves. The same general rules for cylinders also apply to rotary actuators. Use a meter-in circuit when the load always offers a positive resistance to flow and a meter-out circuit if the load is overhauling or negative.

• **Bearing Loading**—Generally actuator shaft bearings are not recommended for external radial, thrust, or bending loads without special bearing provisions being made. Most manufacturers recommended using a flexible coupling between the actuator and the load.

• **Rotation**—Maximum rotation for a vane type actuator is determined by the number of vanes, size of

the vanes, and position of the casing stops. A single vane actuator for low torque may have as much as 330 degrees of rotation. As the number of vanes increases, maximum rotation decreases. A helical-spline or rack and pinnion type actuator can be used for rotation over 360 degrees.

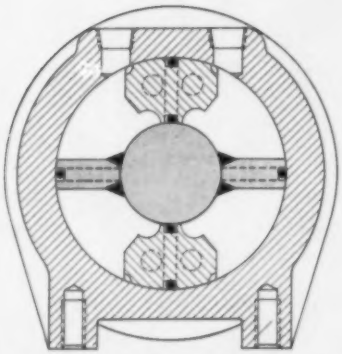
• **Torque**—Output torque for a vane type actuator varies directly with the size and number of the vanes, and the pressure applied to it. Size of the pistons and fluid pressure applied determine output torque for rack-and-pinion and helical spline type actuators. Special actuators have been made with torque ratings as high as 1,400,000 in. lbs. at 1000 psi.

Most actuators operate on air or oil and can be modified for water service.

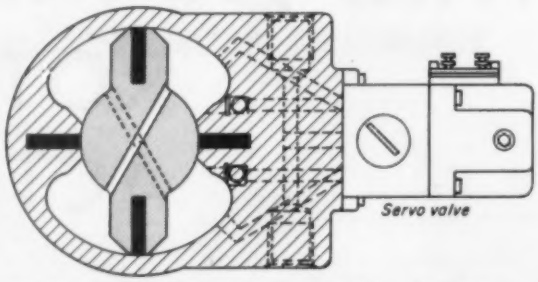
SELECT AN ACTUATOR FOR TORQUE AND ROTATION ANGLE

Manufacturer	Type	Maximum Torque* in.-lbs/100 psi	Maximum* Operating Pressure—psi	Maximum Rotation—deg
BETTIS CORP.	Rack & Pinion	21000	3000	180
CARTER CONTROLS INC.	Helical Spline	5000	300	370
CLEMCO AERO PRODUCTS INC.	Single Vane	1000	4500	330
	Multiple Vane	22000	4500	140
EX-CELL-O CORP.	Single Vane	8400	1000	280
	Double Vane	25000	1000	140
FLO-TORK CORP.	Rack & Pinion	1100	2000	360+
HOUDAILLE INDUSTRIES INC.	Single Vane	10000	4500	280
	Multiple Vane	25000	4500	100
ROTO-TORK MFG. CORP.	Single Vane	10750	2000	280
	Double Vane	21500	2000	100
THOMPSON PRODUCTS, MICHIGAN DIVISION THOMPSON RAMO WOOLDRIDGE INC.	Rack & Pinion	4000	1000	96

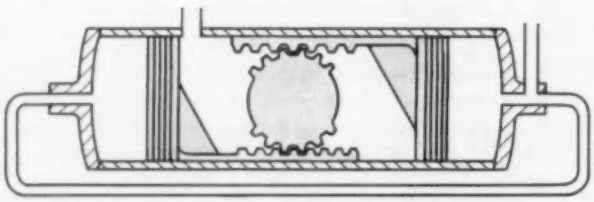
**Special actuators can be made for higher torque & pressures.*



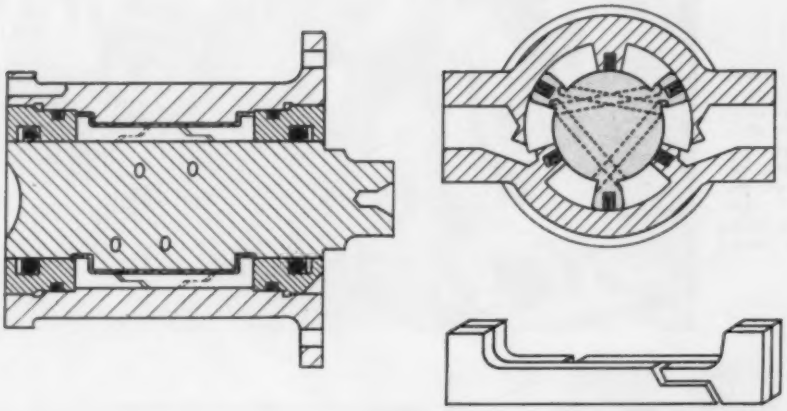
DOUBLE VANE ROTOR gives 100-degree rotation. Single vane design rotates 280 degrees. Seals for vanes and shoes are molded, rectangular shaped O-rings. Dowell pins hold the shoes in place. Journal bearings are used to support the shaft for low torque loads. Roller bearings are used for higher torques. Actuators are flange, foot, or end mounted, operate on air or oil. *Ex-Cell-O Corporation*



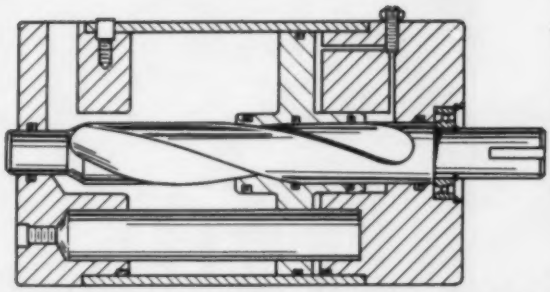
FIXED CUSHIONS DECELERATE THE ROTOR and prevent impact at the end of the stroke. Snubbing occurs when the rotor blades close off the exhaust port near the end of the rotor's travel. When flow to the actuator is reversed, fluid flows through a check valve to start rotation in the other direction. Starting torque is kept low by using Teflon for dynamic seals. The actuator's manifold type body porting allows flange-mounting of servo control valve. *Houdaille Industries, Inc.*



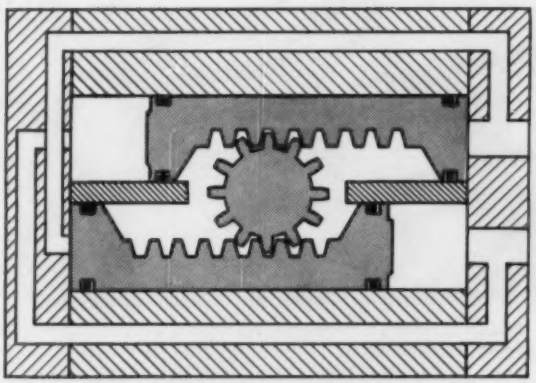
LARGE OPPOSED PISTONS produce high torque at low pressure. A rack, integral with each piston, engages a pinion gear in the center of the cylinder. As the pistons extend and retract, they rotate the pinion gear which is integral with the output shaft. The actuator produces equal torque in both directions. Piston seals are automotive type piston rings. Oil powering the actuator lubricates the racks and pinion. *Thompson Products Michigan Division, Thompson Ramo Wooldridge Inc.*



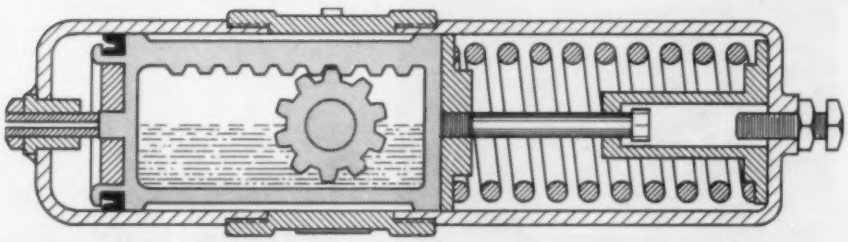
MULTIPLE VANES give high torque in a small envelope. Ports, drilled through the shaft, pressure-balance the rotor. Seals on the rotor and housing are laminated to reduce internal leakage and increase efficiency. They are made in two sections that slide axially on one another. Their joints are staggered so that each joint is sealed by a continuous section of the adjacent seal. Fluid pressure in the actuator presses the seals axially and radially against their sealing surfaces. The patented Teflon or metal seals have a high bulk modulus and do not reduce torsional rigidity or frequency response. This is important since these actuators are designed for aircraft control surfaces. *Clemco Aero Products, Inc.*



OUPUT SHAFT OSCILLATES as the piston moves back and forth in the cylinder. An internal helix machined in the piston meshes with an external helix on the output shaft. Guide rods pass through holes in the pistons to keep it from rotating. The actuator can be stopped at any point in its stroke. Its self-locking helix angle prevents rotation from external torque loads. This also allows the actuator to be positioned with an open-center control valve. Adjustable cushions reduce shock at the ends of the stroke. *Carter Controls Inc.*

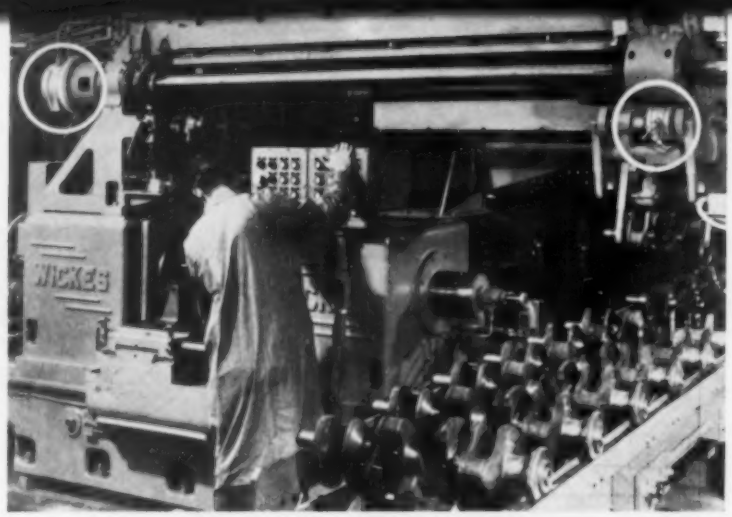


DOUBLE RACK AND PINION design balances forces rotating the output shaft. All moving parts operate in an oil-filled chamber sealed from the operating media. Standard O-rings seal the pistons. Tapered roller shaft bearings permit some thrust loads on the shaft. A built-in relief valve prevents pressure build-up in the gear chamber. Ports are SAE standard, straight thread. *Flo-Tork Corporation*

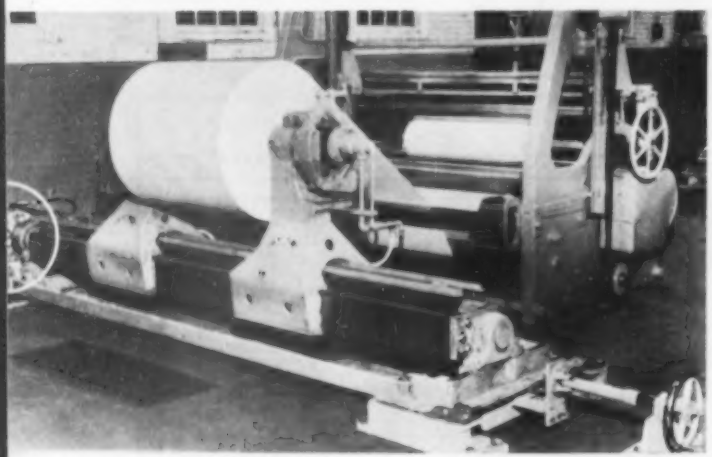


SPRING-RETURN ACTUATOR has adjustable stops. Spring offers fail-safe feature if the operating media is interrupted. Its driving rack and pinion gear operate in oil separated from the operating media by piston seals. Used for valve actuation, the actuator can convert a 90-degree, on-off, rotary valve into a pressure regulator or relief valve. Stops are not needed on the valve being operated since the actuator has built-in adjustable stops. It operates on air, oil or water and can be made double-acting by replacing the spring chamber with a fluid actuator. *Bettis Corp.*

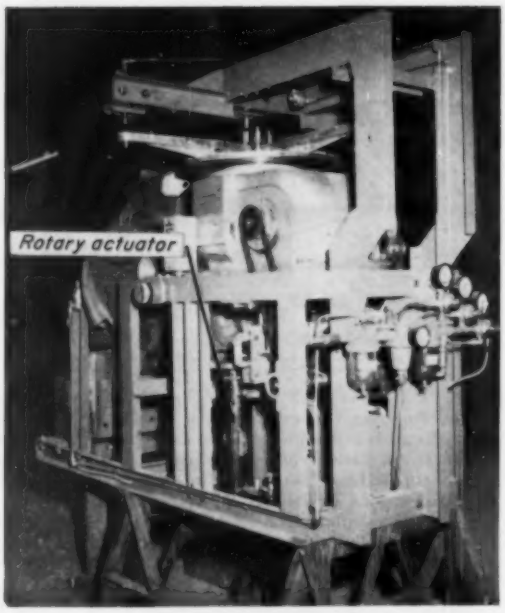
ROTARY ACTUATORS



CRANKSHAFTS are lifted, lowered, loaded, and unloaded by rotary actuators on this automatic crankshaft turning machine. One actuator closes the grips that hold the crankshaft while it is lifted from the conveyor. It operates eccentric clamping cams. Another actuator rotates a pinion which drives a rack to lower the crankshaft into machining position. It then reverses and raises the grips clear of the tools. A similar pair of actuators moves the crankshaft to the next machining position.



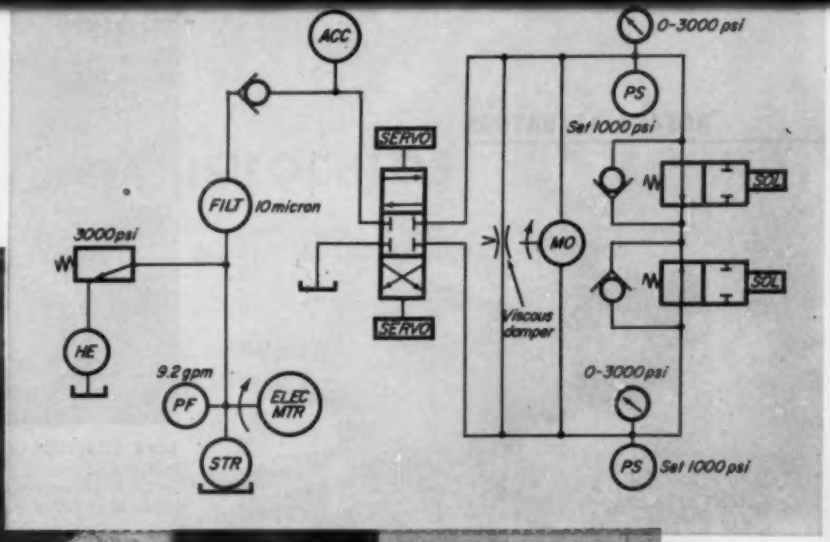
ROLLS OF PAPER for this unwind stand are lifted from the floor and swung into position by a rotary actuator. The actuator turns a beam which pivots about a bearing at each end. The roll of paper is attached to pick up arms mounted on the beam. Flow control valves govern its speed. Pressure of 900 psi locks the actuator when the roll is in position.

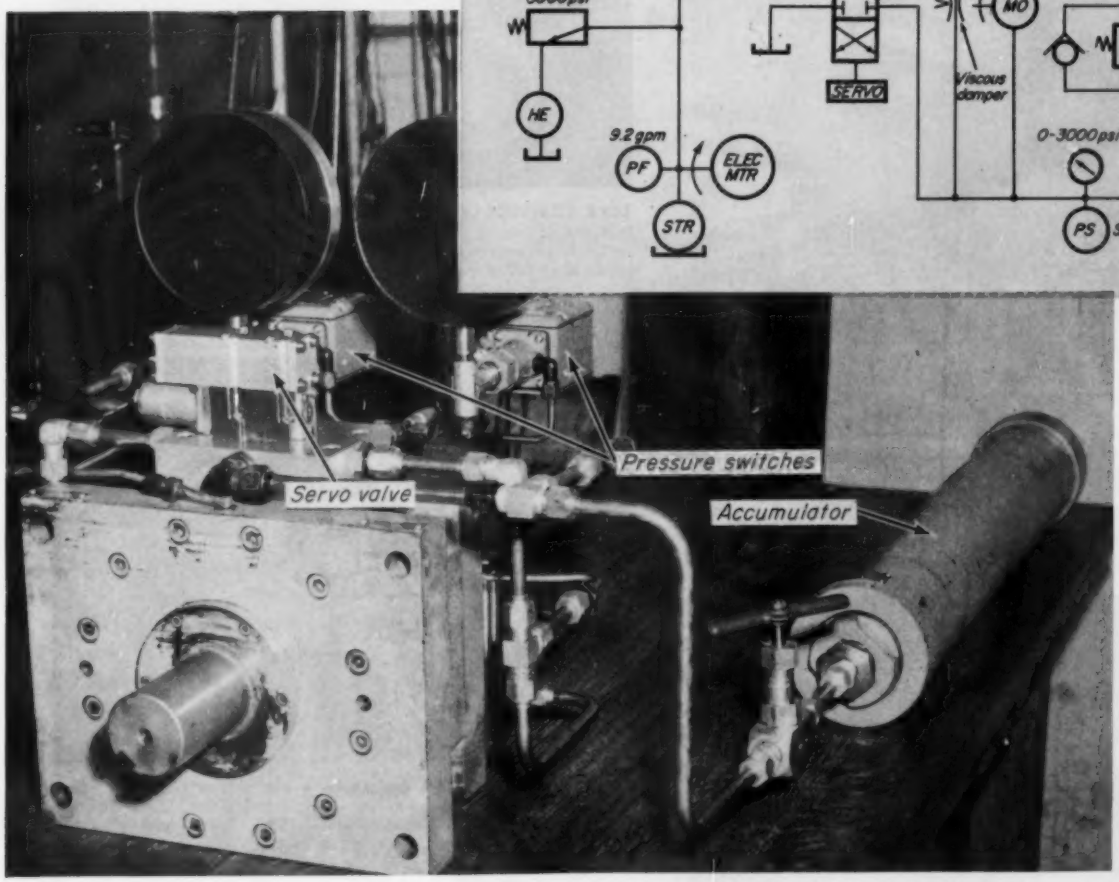


360-DEGREE ROTATION for spraying a design on tea cups. The Schweitzer Equipment Co., Cleveland, Ohio uses a 190-degree rotary actuator driving through a gear box to rotate a tea cup 360 degrees. The actuator also rotates a circular mask, synchronized with the rotating cup. A design is sprayed through the mask onto the cup. The actuator is air powered.

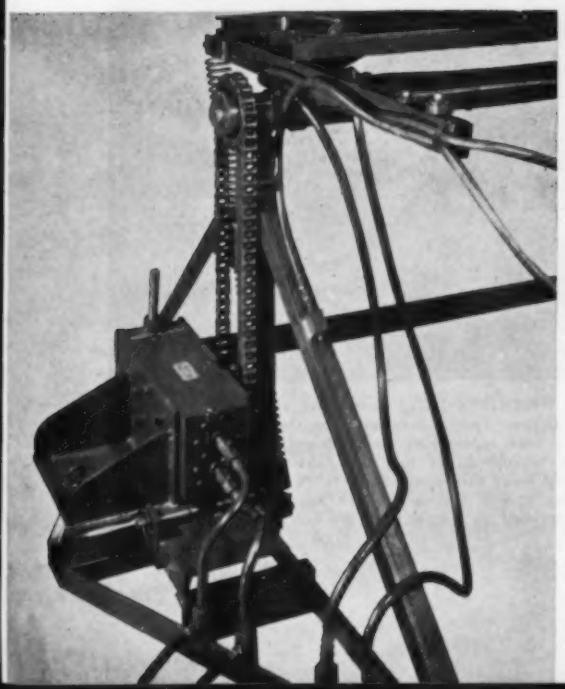
HYDRAULIC DERRICK for utility trucks uses a commercially supplied rotary actuator to rotate and position mast. The actuator develops 54,000 in. lbs torque at 1500 psi. It is a single vane type and rotates the mast 220 degrees. The derricks are manufactured by Tel-E-Lect Products, Inc., Minneapolis, Minn. and are used by telephone companies for digging holes and setting telephone and electric poles.

FLOW CONTROL VALVES at each port regulate speed of the actuator in both directions. Roof beams for prefabricated house construction are held together for temporary nailing in the frame at the top. The actuator, through a chain drive, rotates the frame 180 degrees which drops the beams onto a table where they are permanently secured with splice plates.

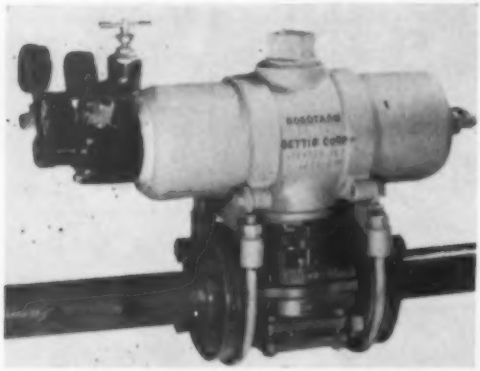




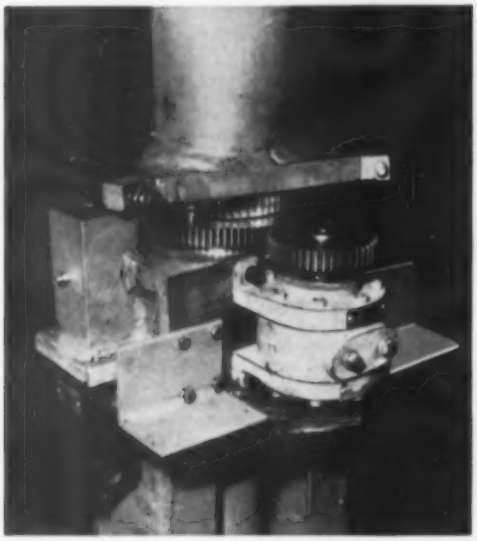
LABORATORY TEST SETUP at Sanders Associates, Inc., for a rotary actuator-powered airborne camera mount used for scanning. An electro-hydraulic servo valve controls movement and accurately positions the actuator. A damping valve prevents the camera from oscillating due to mechanical disturbances in the system which may have frequencies to 30 cps. Hydraulic uncoupling maintains a constant angular velocity regardless of the relative movement of the mount. A pressure switch at each of the actuator's ports de-energizes a solenoid valve to bypass oil when the pressure reaches 1000 psi. The actuator has a torque rating of 42,000 in. lbs at 1000 psi differential pressure across it.



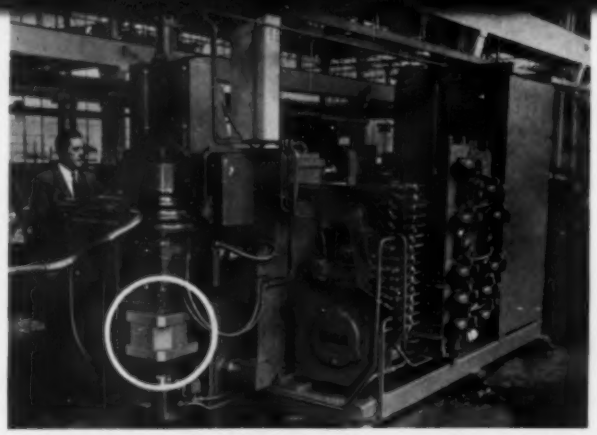
ACTUATOR APPLICATIONS



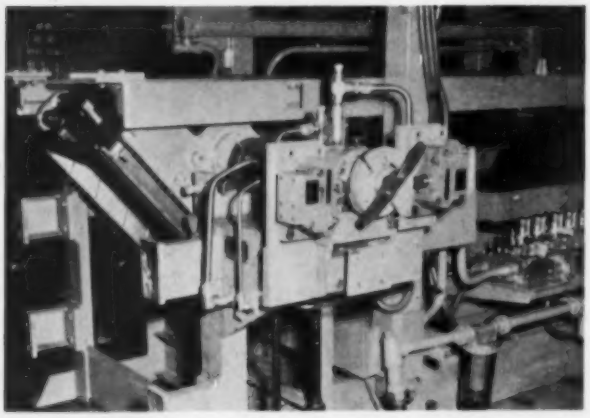
VALVE ACTUATOR uses a built-in valve positioner, operating on pneumatic force-balance principle, in combination with a standard actuator. This throttles or positions a 90 degree rotation valve in direct relation to 3 to 15 psi instrument air signals. Air pressure of 120 psi operates the actuator.



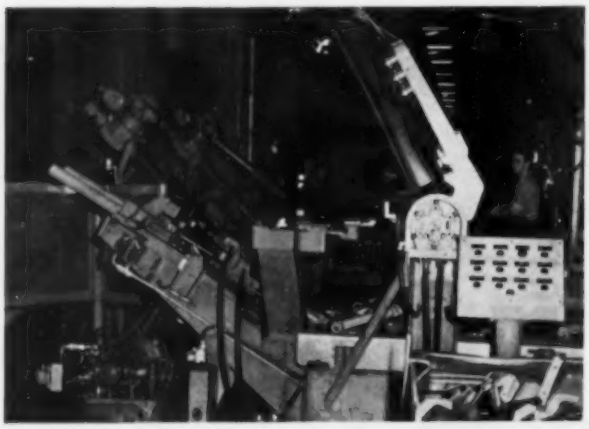
DIE CHANGER TURNTABLE is rotated to three stations 120 degrees apart by this rotary actuator. Designers at Loewy-Hydropress first considered an air cylinder to rotate the table through a lever. Torque variation through the 120-degree angle forced them to abandon this design. The second consideration was a cylinder-driven rack rotating a pinion gear attached to the turntable. This design proved costly and required more space than was available. The final design uses 240 degrees of the available 270-degree stroke of a rotary actuator. With a 2:1 reduction gear the turntable rotates 120 degree. A ratchet and pawl allow rotation in one direction only.



TAPE CONTROLLED ACTUATOR bends steel tubing for muffler tailpipes. It rotates the bending die shaft in accordance with a signal input from punched tape. The actuator operates at 800 psi and bends over 750 different tailpipe shapes.



CORE BOX TURNOVER is done by a 180 degree vane type rotary actuator at this station in an automatic foundry line. Cams attached to the shaft extension operate deceleration valves cushioning the ends of the stroke.



WORK PIECE TURNOVER on an automotive stamping transfer line is done with a vane type rotary actuator. To get controlled deceleration, radial cams rotate with the shaft and trip limit switches 20 degrees before completion of the 180 degree turnover. The limit switches shift the 4-way directional valve to its closed-center position. The time it takes to shift the valve is the deceleration time. This deceleration is controlled by the taper of the valve spool lands.

Hydraulic coiler reciprocates and holds constant tension

• By **OSCAR MAST,** *Designer, Technical Office, Kiriat Bialik, Israel*

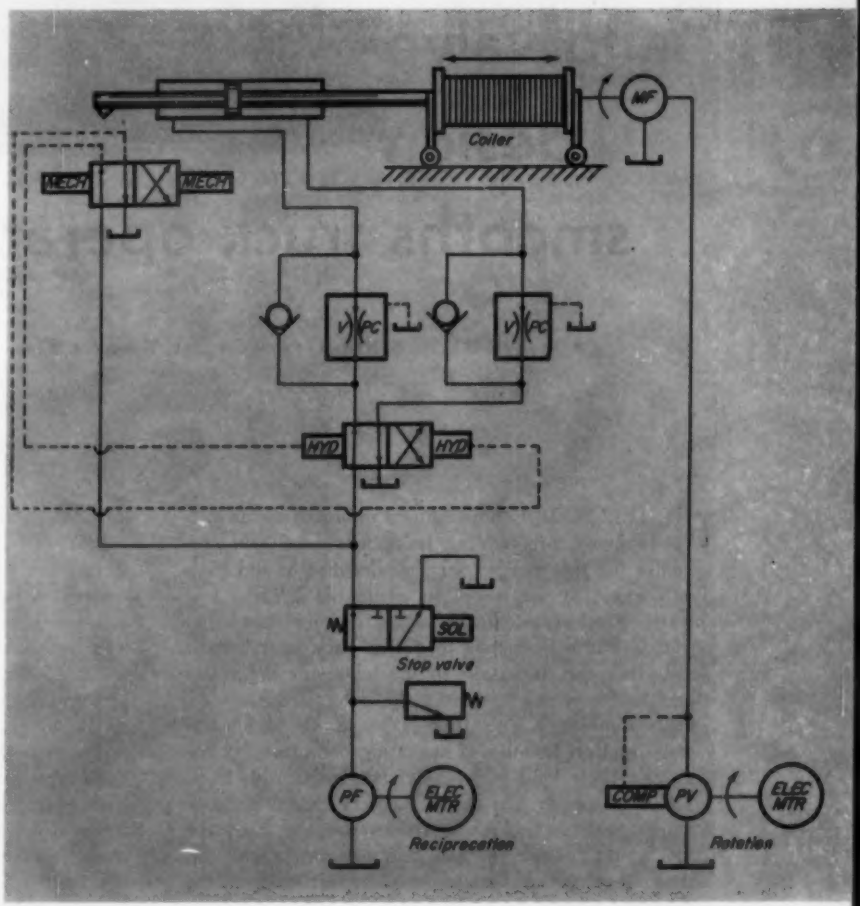
This article was awarded honorable mention in the 1959 HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

TO HOLD constant tension when coiling aluminum wire from an extrusion press, the coiler's rotating speed must vary according to extruding speed. This in turn depends on billet length, resistance to extrusion, and temperature. A pressure-compensated pump supplying the coiler's fluid motor drive keeps pressure—and tension—constant regardless of speed.

• **Coiler Rotates**—The ROTATION pump supplies fluid to the hydraulic motor which drives the coiler through a splined shaft. The extruded wire must be kept under tension as it winds on the coiler. But the coiler's pulling force cannot exceed (the yield stress of the hot aluminum) x (the wire area). A radial piston pump was designed to coil wire of various diameters. Its rotor spring can be adjusted to vary the pump's maximum delivery. Here's how the pump's pressure-compensated feature keeps constant tension in the coiler.

Suppose one part of the billet extrudes faster than the previous section. This briefly reduces the amount of torque required by the fluid motor, and line pressure drops. To maintain constant tension in the wire, the coiler and motor must rotate faster, requiring greater pump delivery. The compensator senses the reduced pressure and moves the pump rotor to increase delivery. This increases motor speed to take up slack in the extruded wire. The pump then maintains the delivery to hold this tension.

After each extrusion cycle, a mechanical detent stops the coiler, so no relief and replenishing components are necessary for the hydraulic motor. Also, because of low torque and speed requirements, the hydraulic motor is small, and its inertia is not significant during stopping.



COILER CIRCUIT rotates and reciprocates a reel to wind up ⅛" to ¼" diameter, hot, extruded, aluminum wire. Pressure-compensated pump keeps tension constant regardless of extruding speed.

• **Coiler Reciprocates**—A separate, fixed displacement pump actuates the coiler cylinder which continuously reciprocates the rotating coiler. The rate of reciprocation is controlled by metering-out valves in both lines. The STOP valve unloads pump flow when the coiler stops. Its solenoid is energized when the wire is completely wound on the coiler and the rotor of the rotation pump centers. ▼▼▼

Cylinder and valve design smooths truck operation

• By **RUSSELL W. HENKE,** *The Heil Company, Milwaukee, Wisc.*

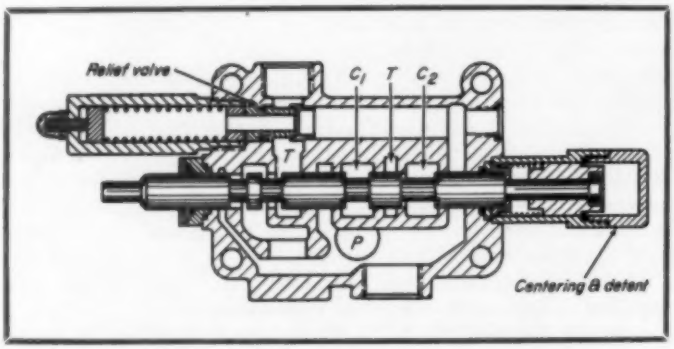
THE TELESCOPIC hoist shown mounted on an off-the-highway, ore hauling truck was developed specifically for this rugged service. Because of the high dump angle of the body, its center of gravity frequently goes over-center, that is, beyond the hinge point, and it is necessary to pull it back over center. To do this, the first stage of the telescopic hoist was made double acting to retract the outer sleeve.

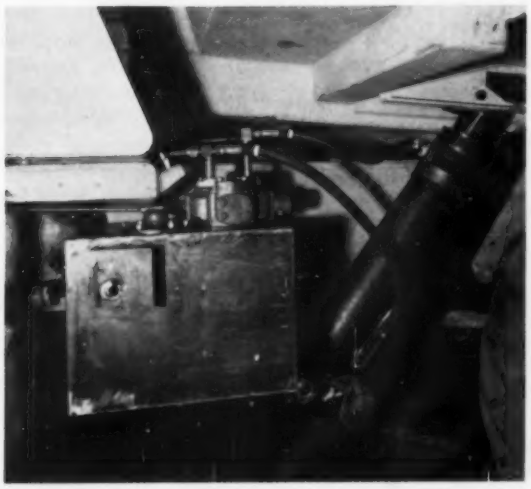
This doubling-acting first stage produced an unusual situation because of operating conditions. After dumping their load of ore, drivers frequently drove off with the body up, or on the way down. Because of the rough terrain these trucks operate over, the body would bounce up and down as the wheels hit holes or hummocks. This imposed impact loads on the hoist. Because of the area differential across the first section of pull down sleeve, extremely high pressures were built up between the outer cylinder and first sleeve—sufficiently high to bell-out the outer cylinder and prevent the hoist from operating. This problem was eliminated by connecting a pressure relief valve set at 1500 psi in the line to the upper port. Excess pressure build-up due to impact bypasses over the relief valve back to tank.

To cushion the fall of the body as it returns to horizontal after dumping its load, a check valve and orifice are in the inlet port at the bottom of the cylinder. Inlet oil freely enters the cylinder as it extends; return oil must pass out through the orifice as the body falls, slowing its descent. ▼▼▼

A SPECIAL, 4-POSITION CONTROL valve is manifolded to the oil reservoir. This valve provides: raise, hold, lower, and a special float position. It is spring centered for the raise, hold and lower positions, but detented for the float position. In the latter position everything is floated except the pull-down port of the first stage.

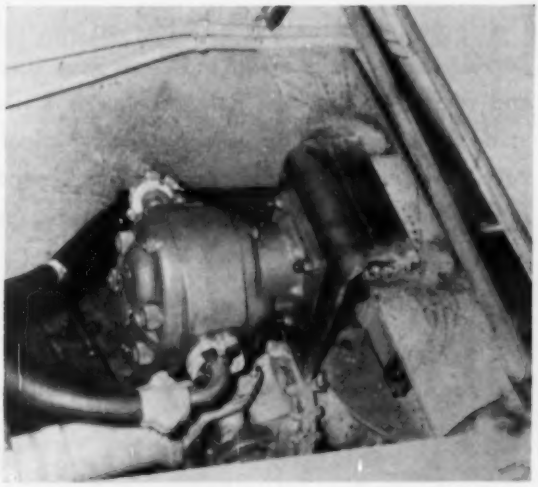
The float position saves power and pump wear. The driver holds the valve in lower position until the double-action has pulled-down the outer sleeve completely. Then the body will no longer be over-center. Then he moves the valve to float; the body continues to lower by gravity; and the pump unloads to tank. Otherwise pump delivery would have to flow over the 1300-psi relief valve as long as the valve remained in the lower position.



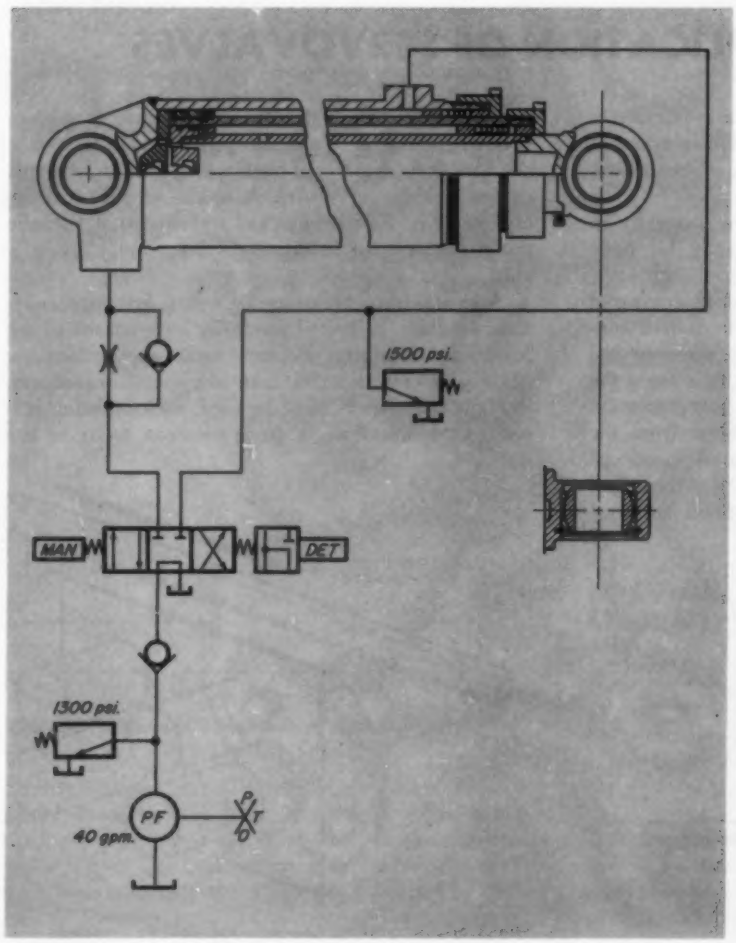


MOUNTING OF THE HOIST and reservoir on the truck is shown. The control valve is manifolded to the reservoir. A heavy gage shield protects the hoist from rocks, mud, and earth.

A 100-mesh, suction filter is in the reservoir. All hoses are 2-wire braid. Connections are 4-bolt, split flange or SAE, straight thread. There are no pipe threads in the system.



THE SYSTEM IS PRESSURIZED by a 40-gpm pump driven by a power take-off. Relief valve setting normally is 1300 psi although the system can operate at 2000 psi.



SNUBBING IS NEEDED to reduce the jolt when impact loads tend to pull the cylinders out. With this type of truck the load sometimes sticks in the body and suddenly falls onto the scoop end of the body as it nears the top of its dump angle. Several tons of ore falling onto the duck tail of the body subjects the hoist cylinders to high impact loads. The two cylinder sleeves have ball checks and orifices built in. This allows free flow of oil up into the sleeves when the hoist extends, but restricts flow out of the space between the inner and outer sleeves when the inner sleeve is pulled out by the load. Oil is forced through the inner sleeve orifice which builds up a controlled back pressure and prevents an impact load from suddenly pulling the sleeve out and damaging the hoist.

When the hoist retracts, the ball checks require the oil to flow through the sleeve orifices. This slows the descent of the sleeves.

The mounting bearings at each end of hoist have spherical bearings held in place by retaining rings.

This three part article is a primer on electrohydraulic servo systems. Part 1 which appeared in the June issue discusses types of servo valves and what they can do. Part 2 below is a review of important considerations in designing servosystems and shows typical applications. In the October issue, Part 3 will outline design requirements on specific systems and tell how they were met with electrohydraulic servo systems.

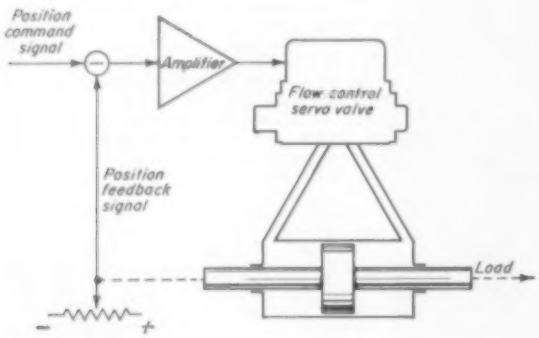
Electrohydraulic servovalves in industry

• By **HARVARD B. KOLM,** *Manager, Industrial Division, Moog Servocontrols, East Aurora, N. Y.*

PART 2—APPLICATION OF SERVOVALVES

FLOW CONTROL servovalves meet the requirements of most electrohydraulic systems. Other types of servovalves are used only where special conditions require them.

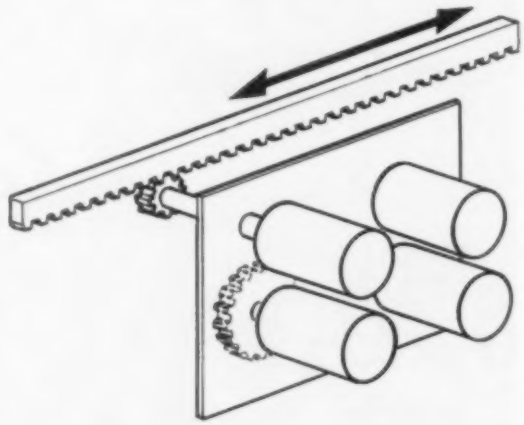
Electrohydraulic servovalves are used primarily in feedback control systems and occasionally for open loop control. In feedback control (or servocontrol systems) a controlled output is continuously compared with a command signal representing the desired condition. The difference between these two is represented by an *error signal* which is amplified to actuate the servovalve. The servovalve actuates the output element in a direction to reduce the error. Flow from the servovalve continues until the error signal is reduced to zero. Because of the integrating feature of the servovalve and actuator combination, positional accuracy can be very high.



TYPICAL electrohydraulic servocontrol loop.

A typical electrohydraulic servocontrol loop consists of an electronic amplifier, an actuator such as a cylinder or fluid motor, a feedback transducer or transducers and the servovalve. A source of electrical energy supplies the amplifier and transducers. Hydraulic power is connected to the servovalve.

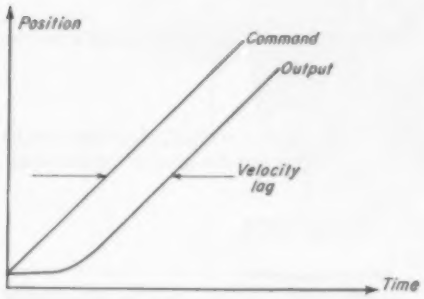
• **Servosystem Accuracy**—Control system, steady-state accuracy is limited primarily by accuracy of the feedback transducer. Because some applications require greater accuracies than any single transducer, multiple transducers must be used, each covering successively smaller ranges. It is common today to use



MULTISPEED synchros give accurate position feedback.

multi-speed synchros as feedback transducers. Several synchros are attached to the output member through different gear ratios. Another method is to use potentiometers or linear transformers for coarse control and then switch to an accurate inductive device such as an inductosyn, for fine control.

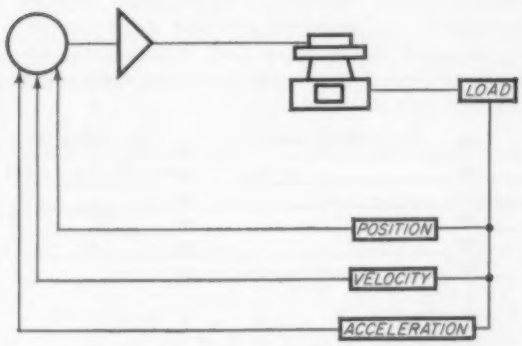
Additional factors which can influence accuracy of an electrohydraulic control system are system gain, type of controller and others. For example, dynamic lags in the system have an influence on positional accuracy of the output member during movement. The nature of the load can influence fidelity of the system.



SYSTEM DYNAMIC lags influence positional accuracy.

A device which has high static friction requires very high loop gains to minimize errors. Changes in environmental conditions applied to the control system, such as temperature and supply pressure, tend to influence accuracy. Fortunately, these influences are now minor.

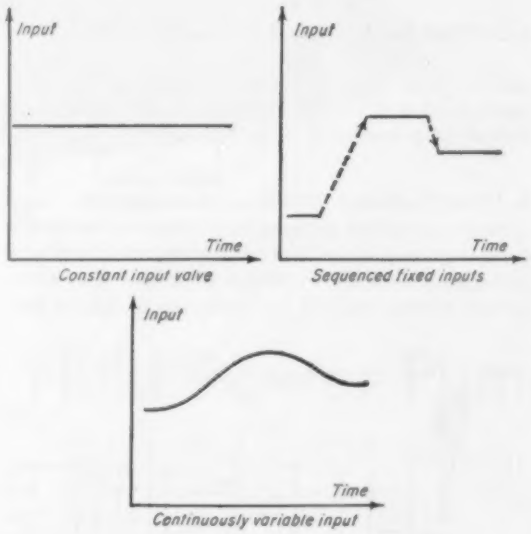
• **Servosystem Performance**—In addition to accuracy, performance characteristics such as dynamic response and stability must also be considered in designing servosystems. To satisfy all system requirements simultaneously, multiple feedback loops or network compensation may be required. In position control systems, it is quite common to use velocity feedback from a tachometer or velocity generator in addition to feedback from the prime position transducer.



POSITION CONTROL system with multiple feedbacks.

Acceleration feedback is also used sometimes. Although servo stability and dynamic response cannot be fully covered in this presentation of fundamentals, it can be stated that electrohydraulic servocontrol systems give the highest degree of dynamic response known to today's technology.

Input is generally one of three types. The first is a constant input reference signal commanding a fixed output despite disturbing influences on the output variable. The second is to produce a sequence of fixed outputs, usually varied with respect to time. Here, only the discrete outputs are of importance; the means of



SERVOSYSTEM INPUT may be either constant, sequenced, or continuously variable.

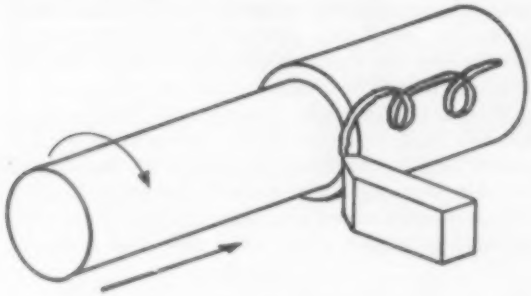
getting from one to another is not important. The third type of input controls the output variable continuously. Performance of the control system using this type of input must be good enough to minimize errors during static and dynamic conditions.

Three basic types of control systems are position control, velocity control and force control.

POSITION CONTROL SYSTEMS

The most common application for electrohydraulic servovalves is in position servocontrol systems. Typical applications are for positioning the cutting head on a machine tool; controlling edge position of metal sheets, paper, or textiles; tilt control on road graders; and hydraulic press brakes.

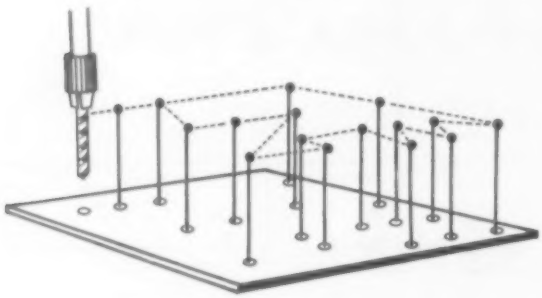
• **Fixed Position Control**—These maintain the control at a constant value. Output position must remain fixed despite load disturbances. The most important performance consideration is the response of output



A CUTTING TOOL may need fixed position control.

position in the presence of load disturbances. A typical example of a fixed position control system is a tilt control of a hydraulic press brake.

• **Point-To-Point Position Control**—The most common industrial application of electrohydraulics is point-to-point position control systems associated with numerically controlled machine tools. Two axis servo-control systems position the workpiece under the tool.

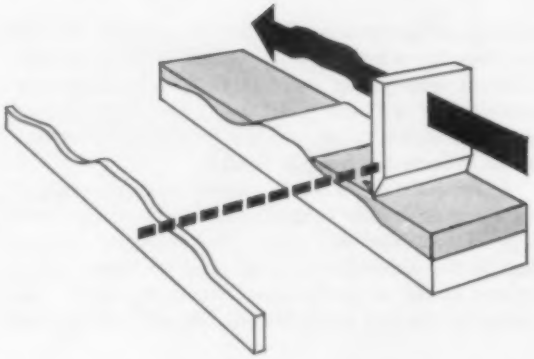


POINT-TO-POINT control may be used for programmed drilling of many holes.

Less sophisticated controls control the cutting tool's feed rate and penetration depth. In some cases, the workpiece is held and the tool spindle moves. In general, the exact path from point to point is unimportant. Positional accuracy of each point, and high speed between points are most important.

• **Variable Position Control**—Machine tool tracer systems are examples of variable position control systems. The command input to the control varies continually and the output follows closely. Although there is often a velocity lag, it can be compensated for in the template used for the variable input.

The input signal in a tracer control system is usually generated by an electrical position transducer which measures displacement of a template representing the normal displacement of the cutting motion. Continuous type numerically controlled machine tools require an electrohydraulic servo which can follow a variable command input. The input in this case is



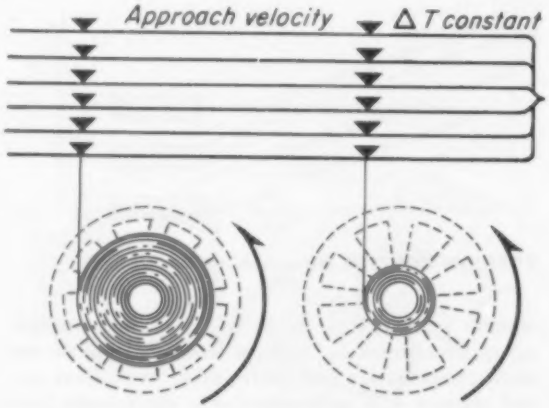
CONTOUR MACHINING is an example of variable position control.

generated electrically by a computer in response to information stored on a magnetic tape or punchtape.

VELOCITY CONTROL SYSTEMS

Velocity, or feed rate, control systems are similar to position control systems except that a velocity transducer or tachometer is used for primary feedback in place of a position transducer. Sometimes the feedback transducer can be omitted and speed can be controlled in a simple, open-loop manner. Speed is then assumed to be directly proportional to the magnitude of the electrical command signal into the servovalve.

• **Constant Speed Control**—A common speed control application of electrohydraulics is for keeping constant output speed in a drive which has variable input speeds. Such constant speed drives are used for driving a-c generators which require precise frequency control. A similar application is on steam turbines where turbine and connected generator speed must remain constant during sharp load disturbances. Another application is in winding processes where speed



CONSTANT WEB SPEED is maintained as material is wound up on reel.

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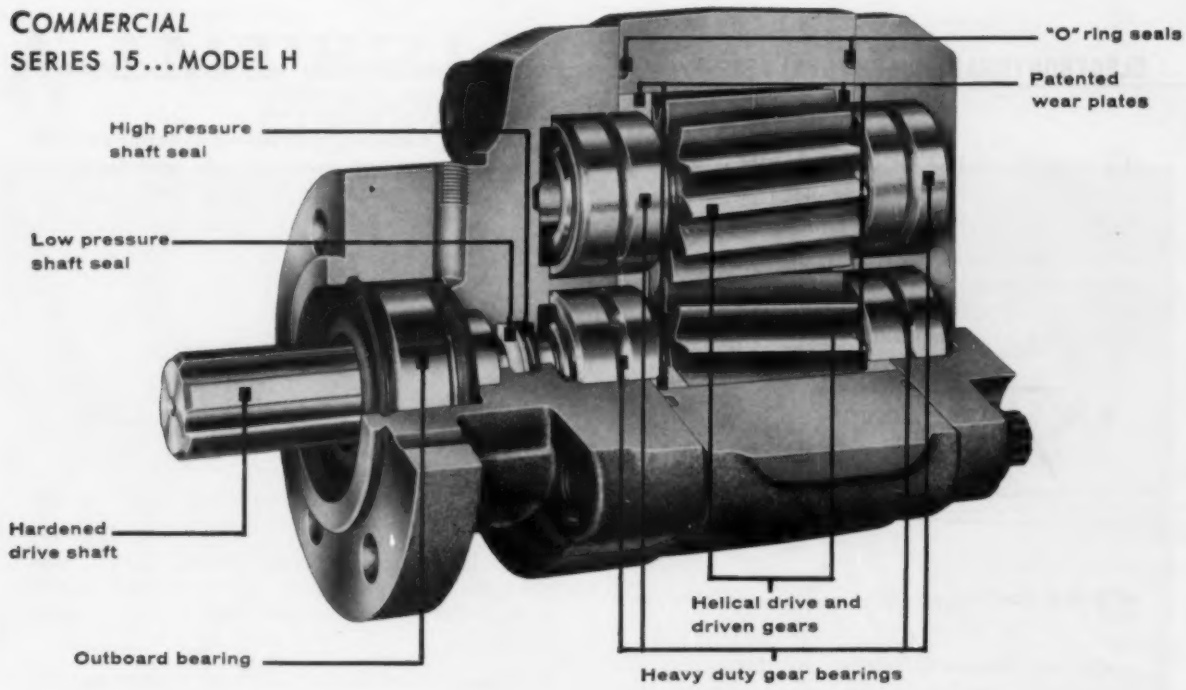

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COMMERCIAL presents the new, Series 15H fluid power pump—a logical extension of its Series 36H line which has received such outstanding acceptance. This small powerhouse possesses all the proven basic features of the larger COMMERCIAL fixed displacement gear pump but is designed for those applications where flow requirements are less. The Series 15H is made in ½", ¾", 1", 1¼", 1½", 1¾" and 2" gear widths and covers a delivery range from 3 to 15 gpm at 1200 rpm. It is recommended for continuous duty operation at pressures up to 2000 psi—at speeds up to 2400 rpm. Volumetric and mechanical efficiency rate over 90%. 15H pumps are available for flange or pad mountings of many styles and can be furnished with ports to accept tapered thread, straight thread or SAE split flange fittings.

High performance for keeps

Perfect alignment is "built in" these pumps because of their unique basic construction which establishes the machining of all parts from one common reference, the gear center line. (See drawing.)

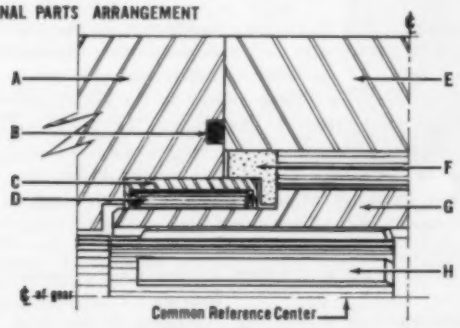
As shown, gear bearings also act as dowels—outmoded dowel pins are eliminated.

Matched helical gears having mirror finish ground on all surfaces contribute to high volumetric efficiency and quiet operation. Thus, complete sealing is maintained—tooth to tooth and tooth to gear housing. Ruggedness, greater load capacity and dampening of unbalanced internal loading are assured by using integral gear hubs to serve as journals for the pump's oversize gear bearings. In order to meet its own exacting standards, COMMERCIAL must, and does, produce its own gears.

A dynamic seal is maintained between gear faces and special bronze alloy gear thrust plates. The entire thrust plate "closes in" against the gear face because of pressure pocketed behind the plate, thus compensating for any wear on its gear contact surface. Because the sealing area is confined to a small portion of the contact surface, the amount of friction has no appreciable effect on pump mechanical efficiency.

Engineering experience available—personal technical service and assistance is yours for the asking. For more information write to Commercial Shearing & Stamping Company, Dept. A-32, Youngstown 1, Ohio.

INTERNAL PARTS ARRANGEMENT



A-bearing carrier B-"O" ring seal C-bearing outer race D-bearing roller
E-gear housing F-floating thrust plate G-gear H-drive shaft spline

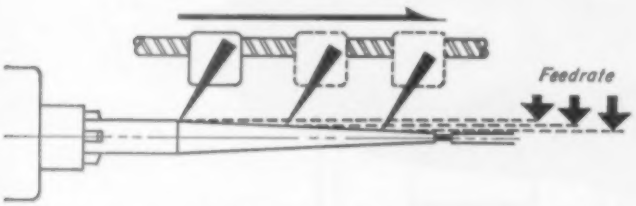
pumps, valves, cylinders, motors

COMMERCIAL shearing & stamping

Circle **33** on Time-Saver Card

of a material winding on a spool is held constant by adjusting the spool speeds as the diameter of the material increases.

• **Feed Rate Control**—Certain applications on machine tools require varying feed rate with other variables such as stroke to compensate for changing diameter on a turning operation, increased thickness, or



FEEDRATE CONTROL is required on some machine tool operations.

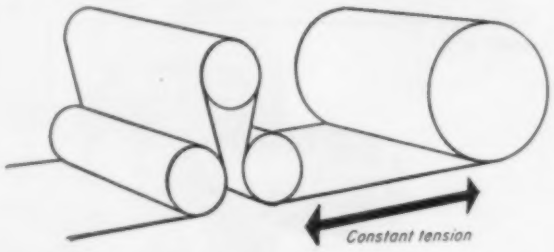
size of cut. Changes in feedrate may be programmed according to time, but they are usually related to position or reaction force on a tool.

FORCE CONTROL SYSTEMS

Electrohydraulic control systems may also be used for applying a precisely controlled variable force or torque to a load or test specimen. Using a pressure control servovalve, an open loop force control system can regulate differential pressure across a load or motor in direct proportion to an applied d-c current. Usually, however, a feedback system having a force or torque transducer is used. Such a system measures torque close to the point where it is to be controlled and eliminates errors due to friction in the actuator or mechanical linkage.

In systems using feedback, a pressure control or flow control servovalve may be used. The latter is more common because it has higher pressure gain than the pressure control valve and this permits a very high degree of accuracy.

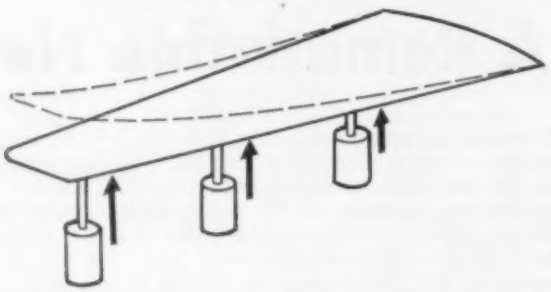
• **Tension Control Systems**—Electrohydraulic force control systems are commonly used for maintaining a constant tension in sheet metal, paper, or



CONSTANT TENSION must be maintained in most web processes.

textiles in rolling or winding operations. Force control systems are also ideally suited to tensile testing to maintain a constant force regardless of material elongation.

• **Programmed Force Control**—Another application for electrohydraulic force control is structural



STRUCTURAL TESTING is an application of programmed force control.

testing of fabricated elements like jet aircraft wings. A battery of force control systems alternately spaced along the length of the wing span apply load distributions typical of those found in flight. ▼▼▼

Gain, Stability, and Frequency Response in Servo Systems

A man sitting down to design a tape controlled machine is immediately confronted with new problems. The tape controlled machine is a servo system, from tape to tool. Certain well defined design principles must be followed. All system parameters must have related values to produce stable operation over the entire speed range. Servo systems perform according to the speed of response of the various elements making up the system, and natural frequency is an important characteristic common to all. Considering the ponderous motion of a milling machine table or column during a heavy cut, it may seem superfluous to speak of its *frequency* since it appears to be about one cycle a week. Nevertheless, a heavy machine part is subject to many disturbing forces in its slow march towards the end of the cut. The system must have the stability to resist these. Also, its positional accuracy, and the cutter path precision are directly related to the overall system gain. Theoretically, the higher the gain, the greater the accuracy. This immediately becomes related to mechanical design, because the higher the natural frequency of the machine parts, the higher you can set gain without introducing instability.

R. K. SEDGWICK, *Assistant Chief Engineer, Kearney & Trecker Corp.*
National Conference on Industrial Hydraulics, Chicago, 1958

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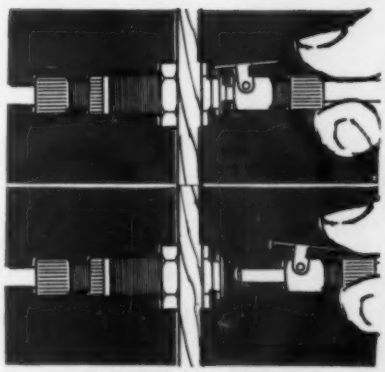

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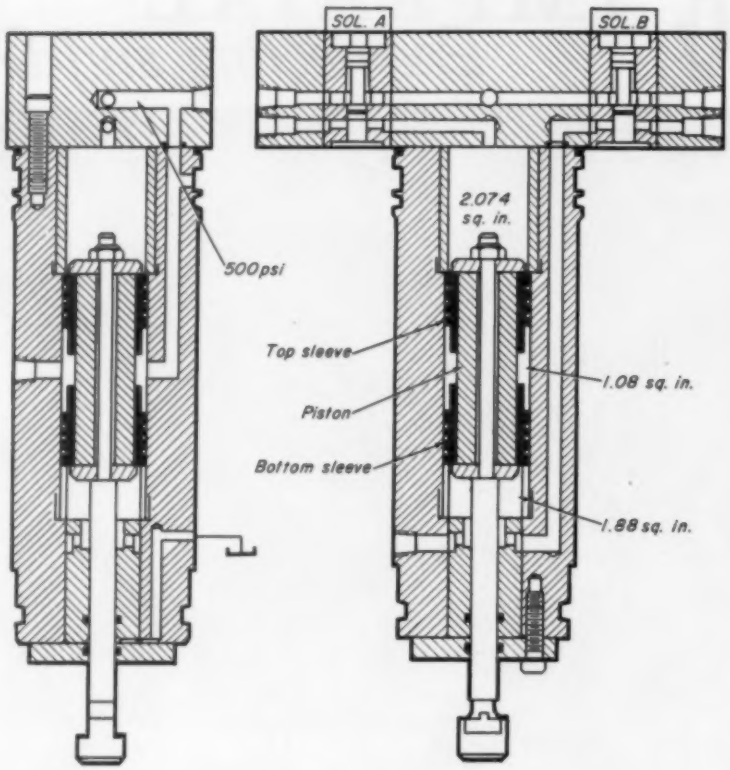
3-WAY SOLENOID VALVES shift actuator into one of three positions. With both solenoids de-energized pressure to the area between the two sleeves holds the actuator centered. The valve spools are small and travel a short distance. This makes the actuator act fast.



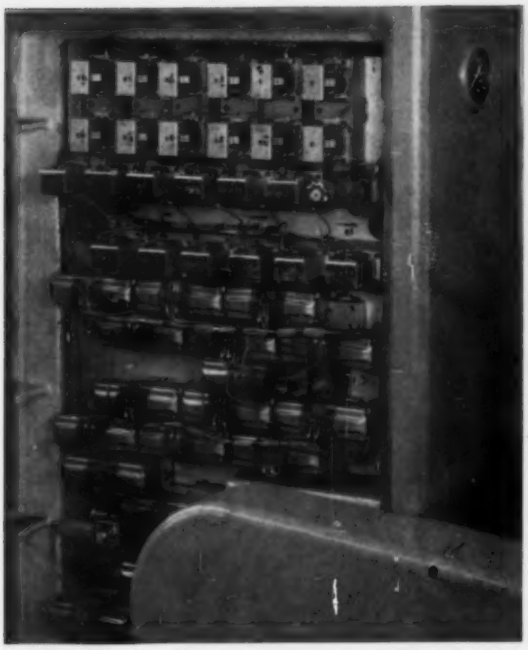
Linear hydraulic actuators operate clutches and brakes and shift gears to change tool feeds and table speeds on this vertical turret-lathe. The clutching and braking actuators have built-in solenoid control valves with small spools for fast shifting. The spools' differential areas return them fast when the solenoids de-energize.

3-position actuators shift

• By **CLAUDE GRINAGE,** *Engineer,*

TWENTY table speeds and sixteen tool feed rates are obtained on this vertical turret lathe by hydraulically actuating clutches and brakes, and shifting gears. Standard 4-way solenoid valves control actuators for changing table rpm. Special 3-position actuators with built in 3-way solenoid valves control tool feed direction. They are designed for rapid movement.

• **Actuator Design**—A piston and two sliding sleeves shift the actuator into one of three positions. Two 3-way valves are built into a manifold at the head end of the actuator. With both solenoids de-energized, the head and rod ends of the actuator are connected to tank. System pressure between the two



SPECIAL VALVE-IN-HEAD ACTUATORS mount on manifolds at the top of the valve cabinet. They shift clutches and brakes in the gear box behind the cabinet. Standard control valves below, operate cylinders that shift gears for changing table rpm.

lathe gears

The Bullard Co., Bridgeport, Conn.

sleeves centers the piston rod. When one of the solenoids energizes, oil flows to the head or rod end, extending or retracting the piston. A relief valve maintains a constant system pressure of 500 psi.

System pressure acts on an area of 2.074 sq. in. to extend the actuator piston. This force is opposed by system pressure on a 1.08 sq. in. area between the two sleeves. Therefore, the effective area extending the actuator is 1 sq. in. With 500 psi system pressure, actuator force is 500 lbs. The actuator developes a force of approximately 400 lbs when it retracts because the effective area is reduced by the area of the piston rod. ▼▼▼

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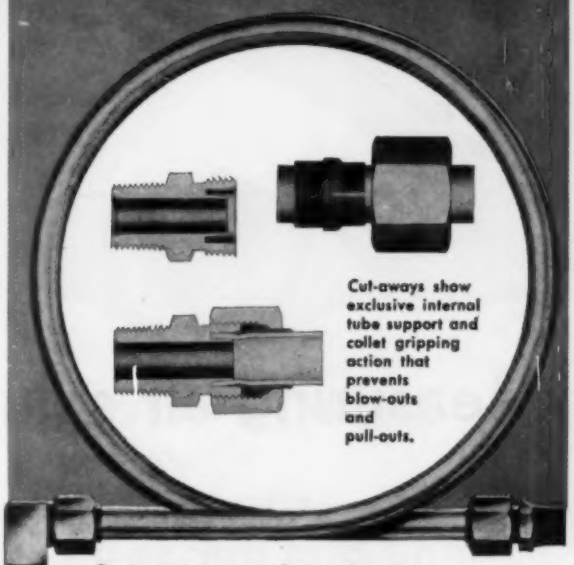

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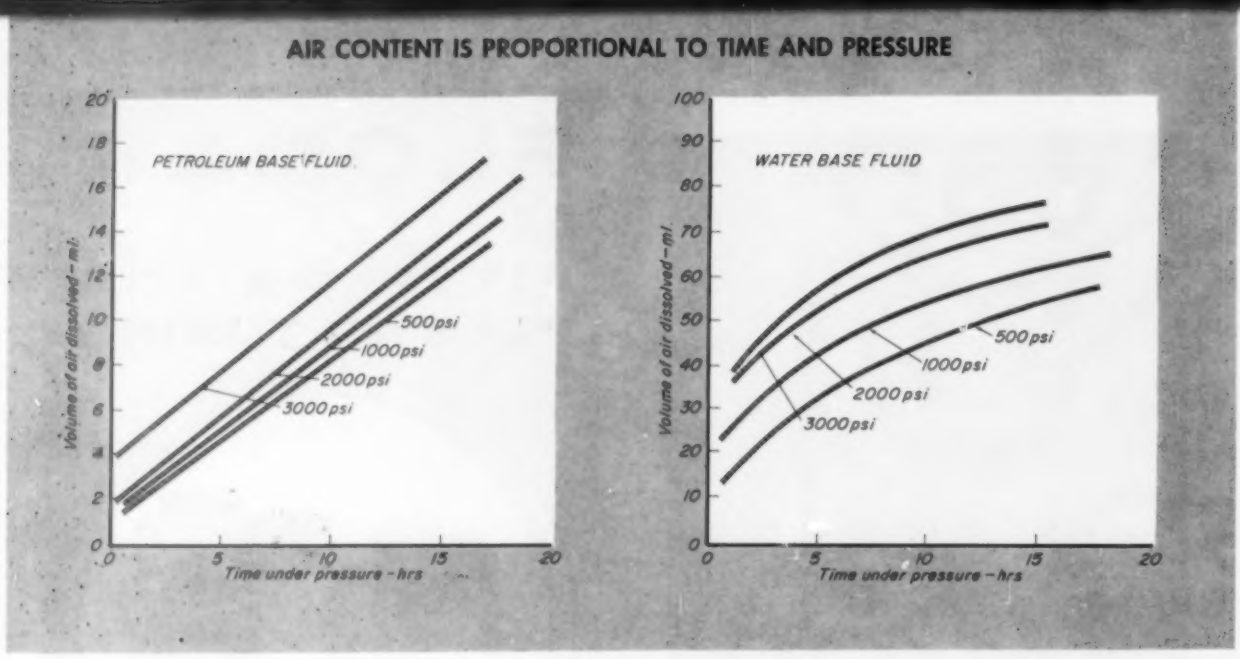

Measuring air solubility in hydraulic fluid

• By **W. E. MacKENZIE and J. SMITH,** *Aeronautical Materials Laboratory, Naval Air Material Center, Philadelphia, Pa.*

AIR DISSOLVED in hydraulic fluids under pressure is released as foam in reservoirs, accumulators, lines, and other components of the hydraulic system. It cuts down performance because of pump cavitation, and poor response. To aid those designing equipment to minimize dissolved air content and permit releasing it safely, the Aeronautical Materials Laboratory tested petroleum base fluids and fire-resistant fluids at various pressures, times, and temperatures.

A mixture of air and a measured amount of the fluid under test was held under pressure in the air side of a piston accumulator. At the end of the test, undissolved air was released from the accumulator and the test fluid with dissolved air was discharged into a flask. Further processing of the fluid in the flask permitted reading volume of air in a burette attached to the flask. Most tests were run for 24 hours, but one test was run for 4 months at 2000 psi to determine actual equilibrium conditions. The results showed almost 50% solution of air (461 ml air in 1000 ml fluid).

• **How Fluids Compare**—After testing various petroleum base fluids and water base, fire-resistant fluids, we found that the water base types absorbed more air than petroleum types. A dissolved air content from 2% to 8% may be expected during normal operating conditions with water base fluid. Equipment should be designed for this 8% air content plus a 200% safety factor for abnormal operations. Petroleum oils with an expected 2% dissolved air content would still be operable in such a system.

• **Air Analysis**—One interesting sidelight is that an analysis of the dissolved air showed an oxygen enrichment. It should be emphasized here that air is not a chemical compound, but a mixture of gases, each having its own characteristics of solubility. Normally, atmospheric air is approximately 21% oxygen, 78% nitrogen, and the balance trace gases. When we analyzed samples of the liberated gases, they showed an increased oxygen content according to time under pressure in the test. Concentrations of over 30% were reached. This is important in correlating bench tests with actual service conditions, because the bench tests were run at atmospheric pressure.

Testing so far has been done at room temperature. Future tests are planned at higher temperatures to 220F. ▼▼▼

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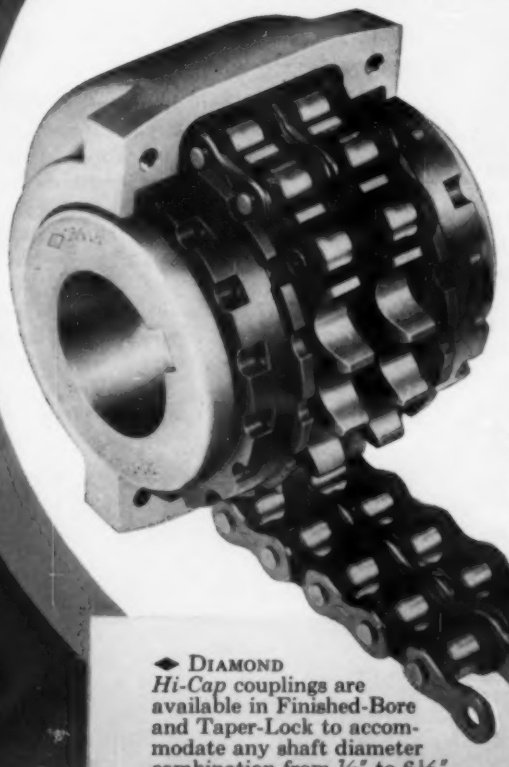

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APPLYING ELECTRICAL CONTROLS

PART 1 - Why solenoids burn out - JUNE 1960

Part 2—Sequence malfunctions

PART 3 - Relay circuitry - OCTOBER 1960

• By D. FITZPATRICK, *Engineering Department, Allen-Bradley Co., Milwaukee, Wisconsin*

PROBABLY every plant engineer and electrical maintenance man has had the maddening experience of an electrically controlled machine which worked beautifully at first but which became neurotic after two weeks or a month. Sometimes such erratic behavior shows up from the very beginning. The machine suddenly skips some operations or repeats others. Perhaps a shot-pin comes in in the middle of an index or transfer. These malfunctions are annoying enough when they are consistent, but when they happen at random, they can be completely frustrating.

The first logical attack on such a problem is, to check for loose wires. Worn or intermittently slipping limit switch cams may be the cause. In one case which defied solution, it was discovered that the hydraulic system pressure had dropped because of a defective regulator valve in the accumulator tank. This can be particularly annoying on systems which use pilot-operated valves.

There are many possible causes of such erratic operation, but two should be emphasized because they frequently do not occur to the maintenance man, although they are often the culprits.

• **Cycle Speed-Ups**—Sometimes, after a machine has been performing satisfactorily for a while, someone gets the bright idea that if it can produce 200 completely machined "raffet bars" per hour, why not speed up the cycle and produce 400? The philosophy here is, of course, that if two aspirins are good, twelve are better. The difficulty which crops up at this point is that increased speed of the machine may result in an insufficient time for limit switch actuation. In turn the relays associated with a given limit switch fail to pick up at times, and the cycle becomes unpredictable. Unless the speed, and mechanical actuating conditions are such that a limit switch is tripped for at least 1/5 of a second, there is no real guarantee that the associated relay will pick up at all. Though most industrial relays pick up within one cycle, the user should remember that this is for ideal voltage and other conditions.

• **Overlapped Contacts**—Transfer type or make-before-break relay contacts are often used in electrical design. These contacts are also variously referred to as *overlap* or *late break*. Sometimes they are used to prevent a *relay race* and other times to avoid the use of interposing relays. In the circuit of Figure 1 with the limit switch actuated, relay 2-CR remains energized. Otherwise contacts of relay 3-CR will drop out 2-CR. Relay 2-CR must have overlapping contacts so its normally open contacts close before its normally closed contacts open. If this sequence is not maintained, a relay race would develop and the actual behavior of this particular circuit would be com-

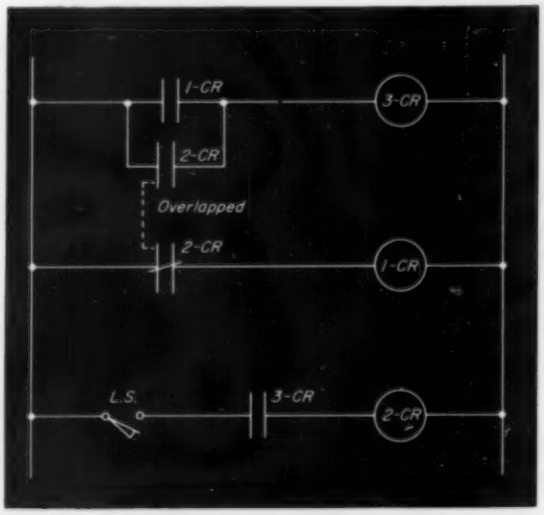

FIG. 1 RELAY 2-CR REQUIRES OVERLAPPING CONTACTS to keep relay 3-CR energized while 1-CR drops out and 2-CR picks up.

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SEQUENCE MALFUNCTIONS

pletely unpredictable. Because of inrush currents and other factors, the circuit might function satisfactorily seven times out of ten, even without overlapped contacts but one cannot play these odds in designing an industrial control system. Hence, the overlap contacts. Why then, even with an overlapped pair, may such a circuit suddenly become erratic in its operation?

One obvious possibility is that after a considerable number of operations, the contacts in question become physically disarranged so that they are no longer actually overlapped. Though this is not possible in most industrial relays, it does happen from time to time.

However, the most common cause of strange behavior of overlapped contacts is high control voltage. Overvoltage amplifies effects of contact bounce which all electro-magnetic switches exhibit to some extent. Even under ideal circumstances, any contact will bounce on closing. When the relay plunger first seats itself, transmitted mechanical forces are usually sufficient to bounce the contacts open again, sometimes several times. No electro-mechanical switch is entirely free of this. With an overly high control voltage, these bounces become much more severe, both in amplitude and number, so that the overlapped contact pair may both be open at the same time during such a bounce. This, of course, is just what is *not* wanted. The solution is to control voltage within the limit specified by the National Electrical Manufacturers Association.

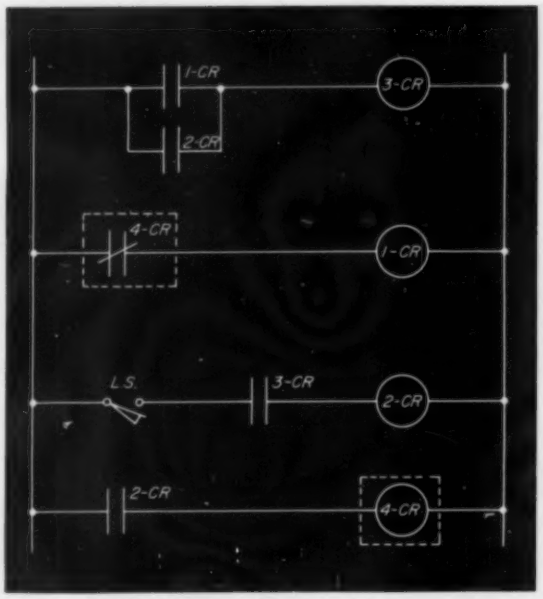

FIG. 2 USING AN ADDITIONAL RELAY, 4-CR, eliminates need for overlapping contacts on relay 2-CR. This avoids trouble caused by improper operation of overlapped contacts or contact bounce caused by overly high control voltage.

However, voltage regulation in a plant sometimes makes this adjustment difficult and an extra relay, 4-CR, will have to be connected. This is illustrated in Figure 2. ▼▼▼

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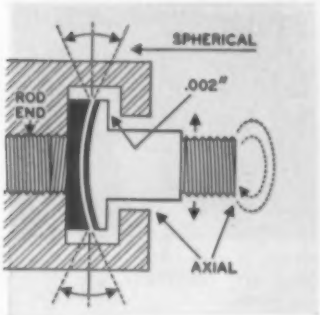

- Reduces cylinder bearing wear caused by side loads and binding
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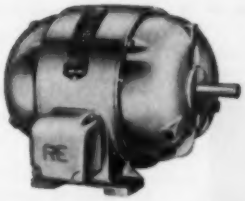

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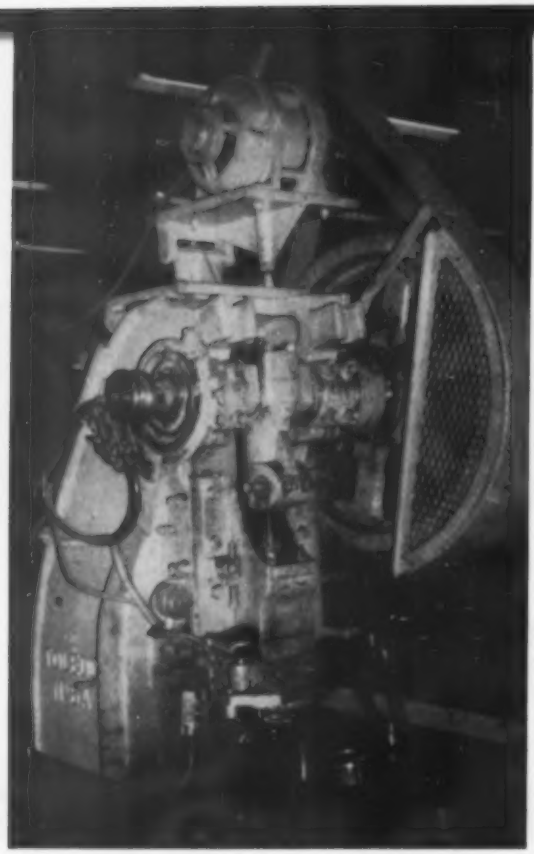
Press safety standard

• By JOHN F. ROSENCRANS
Bowser, Inc., Fort Wayne, Ind.



AIR CONTROL CIRCUIT installed on this mechanical punch press uses standard components. This circuit prevents accidental cycling and requires the operator to press two hand valves to start a cycle.

A CRANK-FLYWHEEL type mechanical press must complete its punch cycle each time the clutch is engaged. The ram can't be stopped once the cycle begins. Many precautions must be taken to prevent engaging the clutch accidentally.

An air cylinder engages the clutch on most presses. The pneumatic circuit must have safety features which prevent repeating or cycling if the operator ties down either hand valve.

The pneumatic system on this press meets all these requirements and uses standard components. The system also coordinates an automatic die transfer with the press cycle.

• **Separate Pilot Circuit**—A pressure reducing valve supplies 40-psi air to the pilot circuit. This circuit controls a double-diaphragm-operated, 2-position, 4-way valve that extends and retracts the die transfer cylinder. Retracting this cylinder initiates the press cycle.

At the beginning of the cycle, the die is fully extended for loading. Two 3-way valves are hand operated simultaneously to retract the die transfer cylinder and start the press cycle.

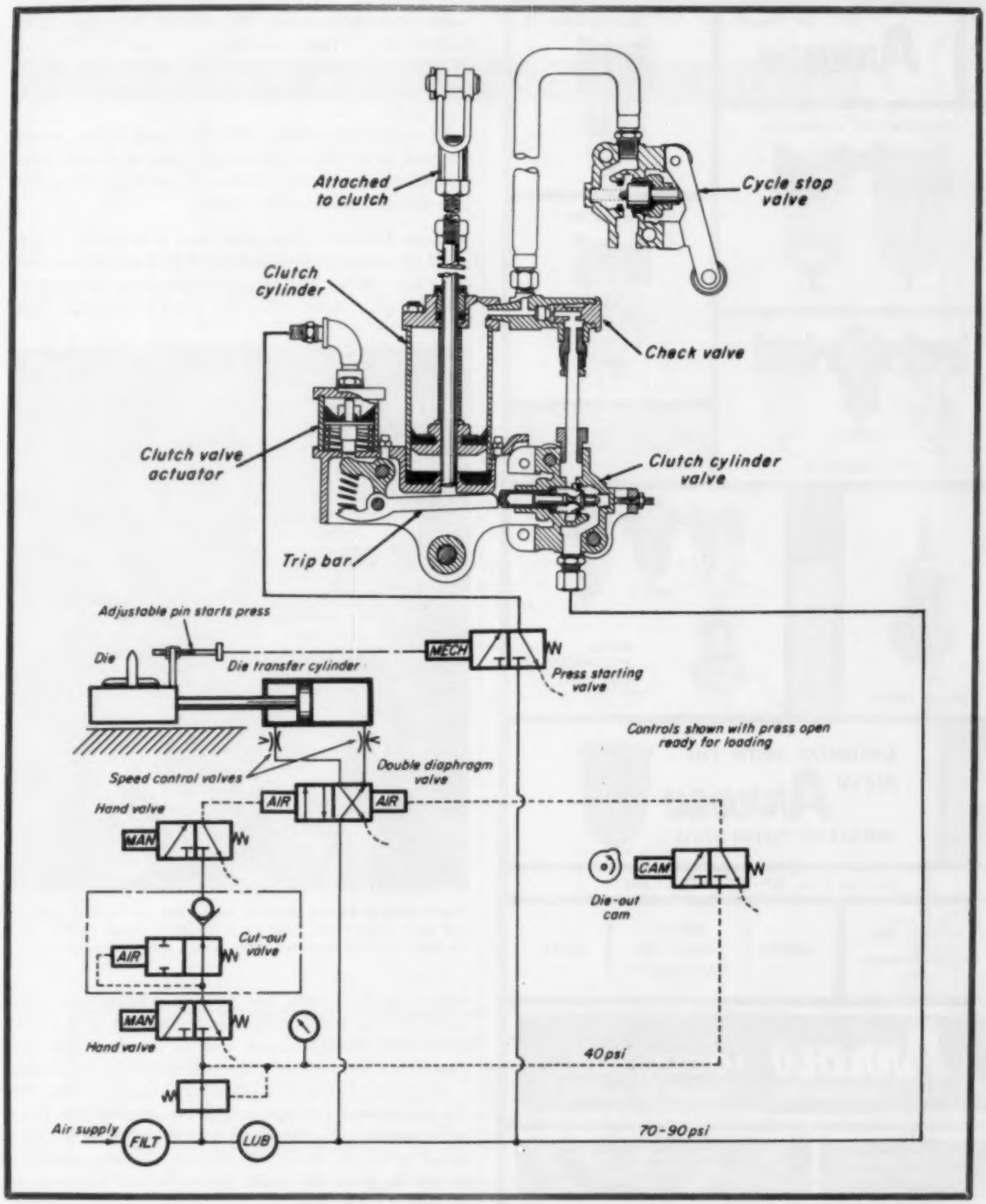
A cutout valve installed between the two hand valves prevents cycling the press with either of the hand valves held in their open position. The cutout valve allows a fixed quantity of air to pass on each cycle. When a set amount of air passes through the valve, it cuts out. Additional air can't pass until the air exhausts on both sides of the valve. The hand valve on each side of the cutout valve must exhaust before another cycle can start.

At the completion of the cycle, a cam mounted on the crankshaft actuates a 2-position 3-way valve in the pilot circuit. This valve shifts the die transfer cyl-

CAMS ATTACHED TO THE PRESS CRANKSHAFT, actuate valves to extend the dies to loading position and exhaust the clutch operating cylinder at the end of the cycle.

CLUTCH OPERATING CYLINDER and valve assembly prevents repeat or accidental cycling. Air applied to the valve actuator shifts the trip bar through a right angle lever. The trip bar pushes the clutch cylinder valve actuator, opening the valve and directing air to the clutch cylinder. When the clutch cylinder retracts to engage the clutch, an extension on its rod pushes the trip bar off the valve actuator. The check valve holds pressure on the clutch cylinder until a cam on the crankshaft rides off the cycle stop valve, exhausting the cylinder. The clutch can't be engaged again until the cam closes the cycle stop valve. Courtesy A. Schrader's Son, Division of Scovill Mfg. Co., Inc.

circuit uses pneumatic components



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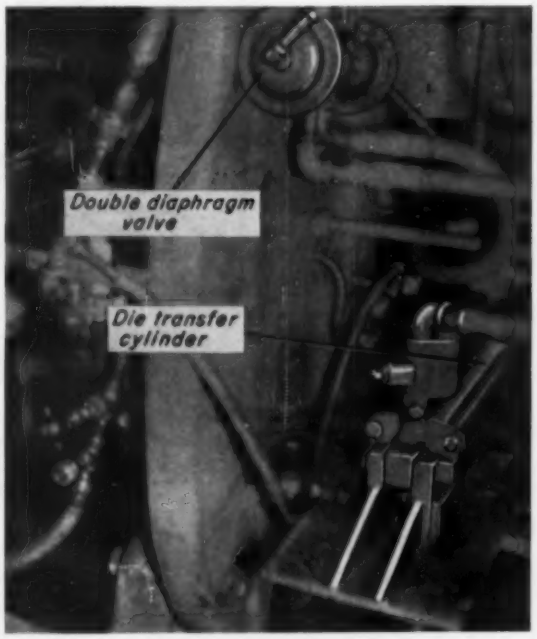
PRESS SAFETY CIRCUIT

inder control valve returning the die to loading position.

• **Safe Clutch Operation**—An adjustable rod, attached to the die block, shifts a 3-way valve when the die reaches pressing position. This valve directs air to the clutch operating mechanism which consists of a small actuator that shifts a 3-way valve through a trip bar. When the valve shifts, the clutch operating cylinder retracts, engaging the clutch. The trip bar is pushed off the valve actuator by a rod extension on the clutch actuating cylinder. This action closes the 3-way valve to the clutch cylinder and prevents a repeat cycle.

When the ram returns after the press stroke, a cam attached to the press crankshaft opens a shutoff valve exhausting the clutch cylinder. A spring returns the cylinder and releases the clutch.

• **Cam Design**—The cams were first made of plywood so that several shapes could be tried before steel cams were made. The cam exhausting the die transfer cylinder pilot must allow the pilot to exhaust fully



DIAPHRAGM VALVE shifts to retract the die transfer cylinder and start press cycle. Pilot air at 40 psi is piped to the valve through two hand-operated valves and a safety cutout valve.

before the cycle ends. Too slow an exhaust may cause short cycling and jam the die at the start of the next cycle. The clutch exhaust cam is timed so that the clutch does not recycle at the end of its upward stroke.

The hand valves are placed far enough from the die to prevent the operator from starting the press cycle and moving his hands into the path of the ram when it comes down. A thorough safety checkout should be given the entire system before the press is placed in production. ▼▼▼

Hydraulics & Pneumatics

August 1960

AIRCRAFT SECTION

MISSILES • SPACE VEHICLES • GROUND SUPPORT

PUMP TEST STAND WITH A FUTURE 91

By Robert D. Cameron

A lot of time, effort and money goes into the design of a test stand for pump development. It has to meet future needs as well as present. Here are design details on Bendix's equipment to program a pump through a 1-minute cycle of speed changes, discharge pressure changes, and flow reversals.

BALL VALVES PERMIT COMPACT FLIGHT ACTUATOR DESIGN 98

By W. M. Morrison

Compact actuator design incorporates poppet type ball valves. As part of a flight control servo system, it amplifies input signals from the pilot. Hydraulic failure locks the actuator for direct control by the pilot.

AVIATION NEWS FROM THE FLUID POWER FIELD 104

AIRCRAFT COMPONENT DATA 106

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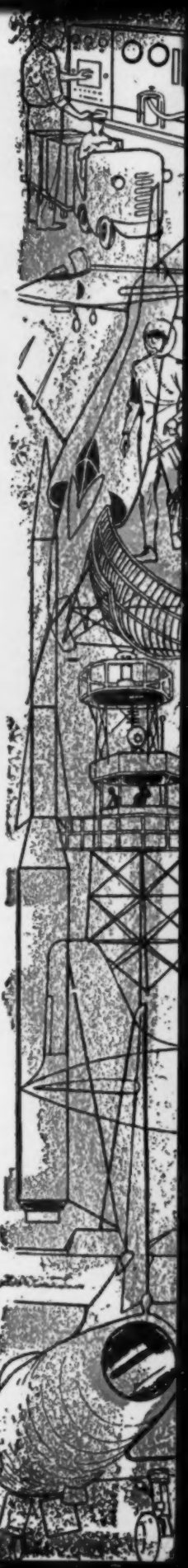

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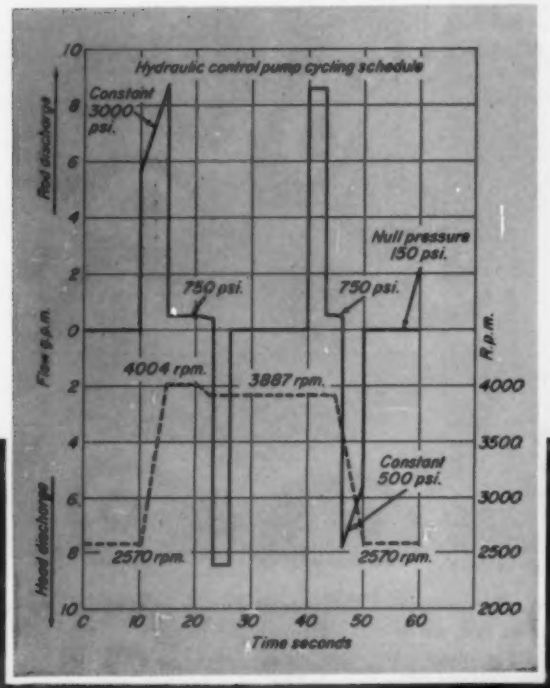
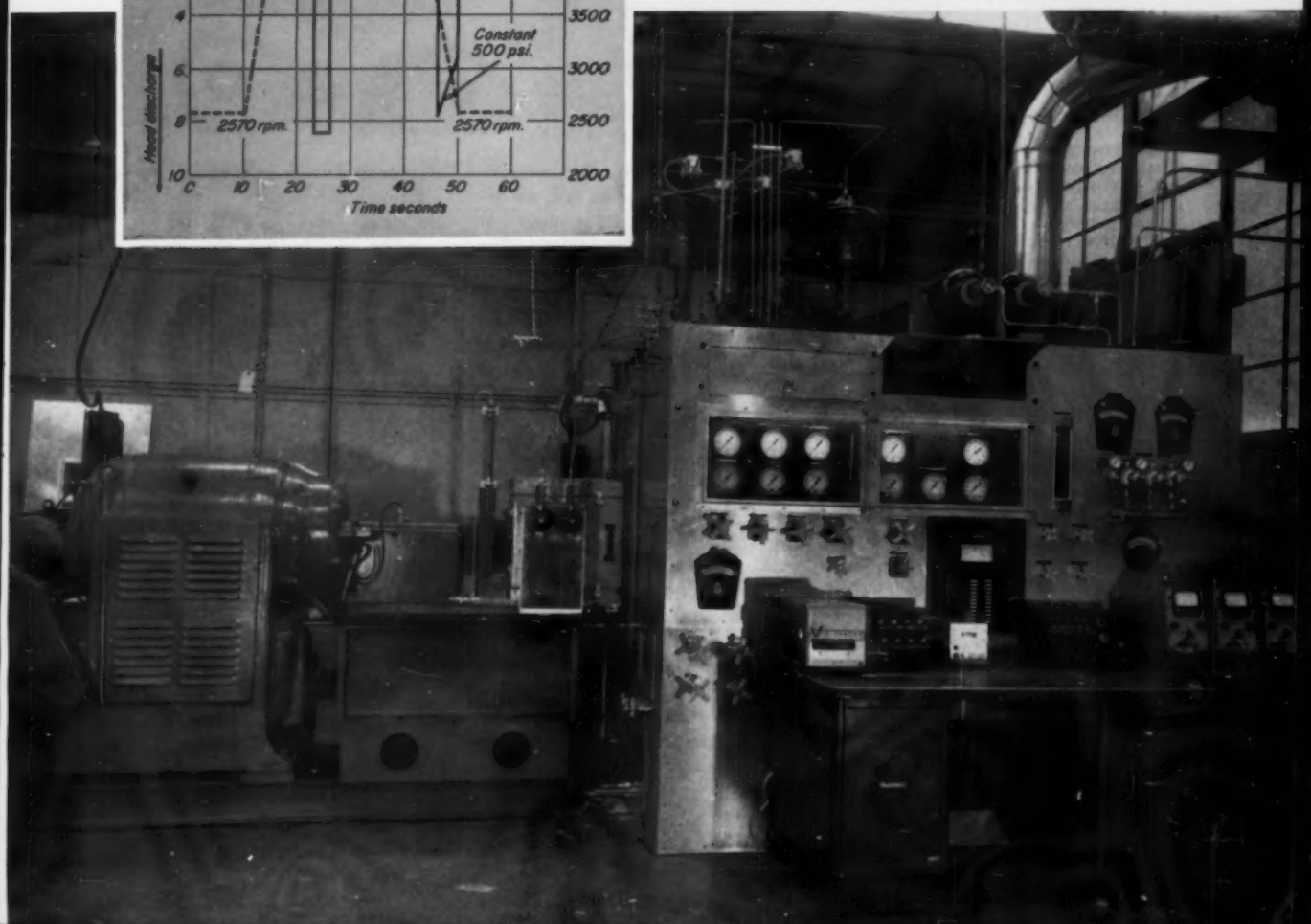
Pump test stand with a future

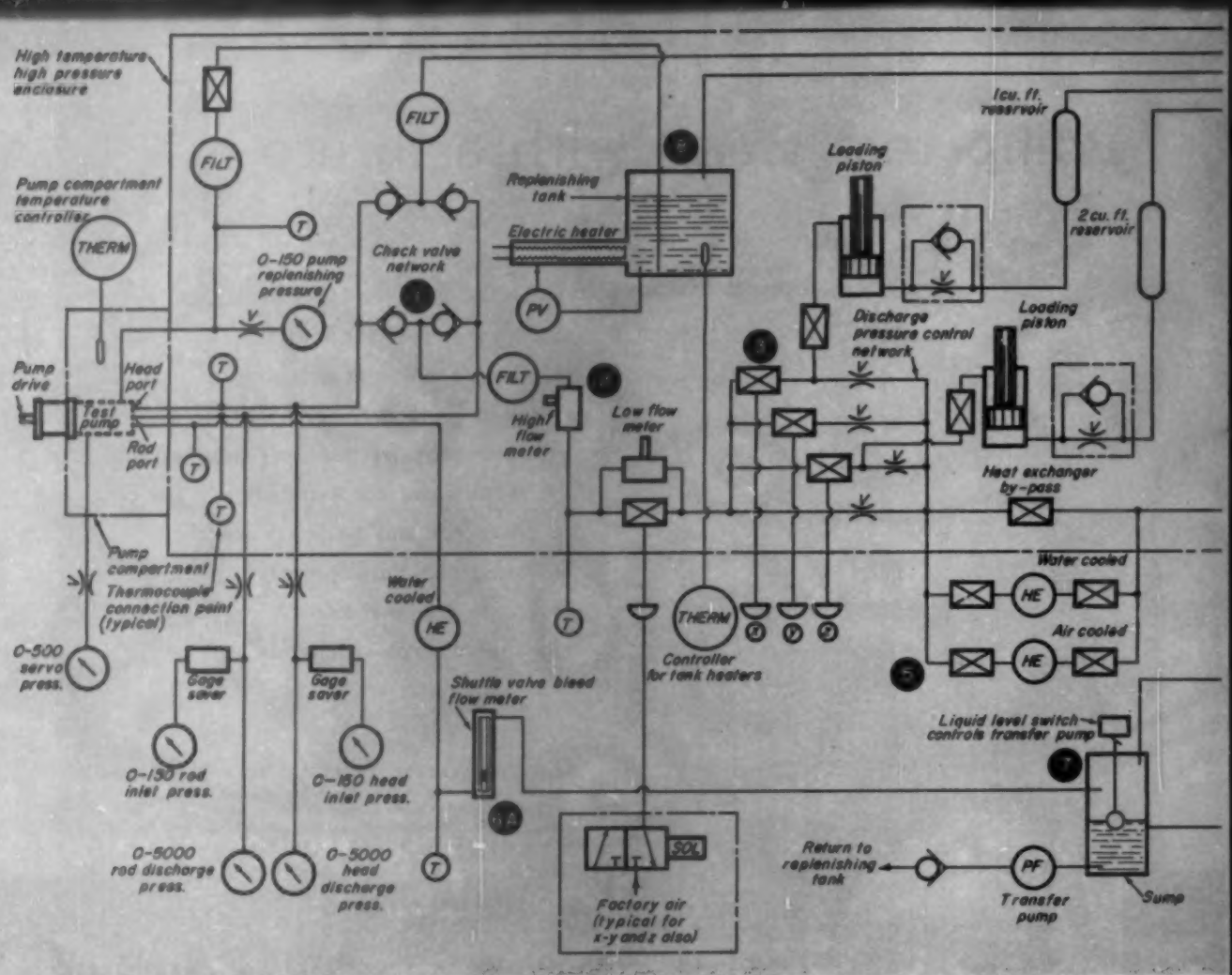
• By ROBERT D. CAMERON
Superintendent, Engineering Test
Bendix Aviation Corp., Utica, N. Y.

Hydraulic pump design moves ahead so fast that test facilities tailored for today's developments may have to be scrapped tomorrow. But here's a test stand with a stretch. Its designers went beyond the requirement for a facility to check out and qualify a specific military pump development, to create one that can handle tomorrow's high-performance pumps, as well.



HIGH-TEMPERATURE HYDRAULIC PUMP TEST FACILITY was designed to operate with fluids at 700 F and permit 60 changes of pressure, flow rate and flow direction in each 60-second cycle, although present requirements are for 600 F and four changes. Graph at left illustrates typical four-change cycle.





CLOSED-LOOP FLOW CIRCUIT for high-temperature test of aircraft pump. Original design called for gear pump and bypassing relief valve to maintain pump replenishing pressure. Designers switched to nitrogen pressurizing system as no suitable 600 F relief valve was available as standard commercial item.

TO CREATE a new engine-driven, aircraft hydraulic control pump, we had to build a new test facility for pump development work and military qualification tests.

The pump test specifications dictated that the test stand should program the pump through a one-minute cycle of speed changes, discharge pressure changes, and flow reversals, for up to 500 hr at fluid temperatures of 600 F and ambient temperatures in the pump compartment of 700 F. Rated flow was to be 9 gpm at 4000 psi, 300 F, and rated speed of 4650 rpm.

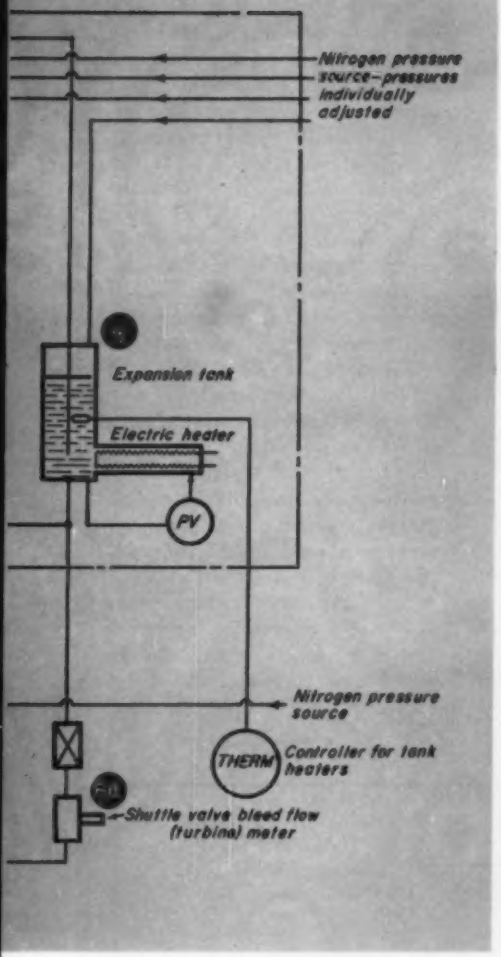
But because aircraft accessory design moves ahead so fast, we decided to build some growth potential into our test facility. The equipment we built will operate a test pump at 700 F fluid, 800 F ambient, and 15 gpm flow. It also includes a programmer-timer that can vary pump speed, pressure and flow direction 60 times in each one-minute cycle. The test program may be changed by a simple rewiring of the timer-programmer.

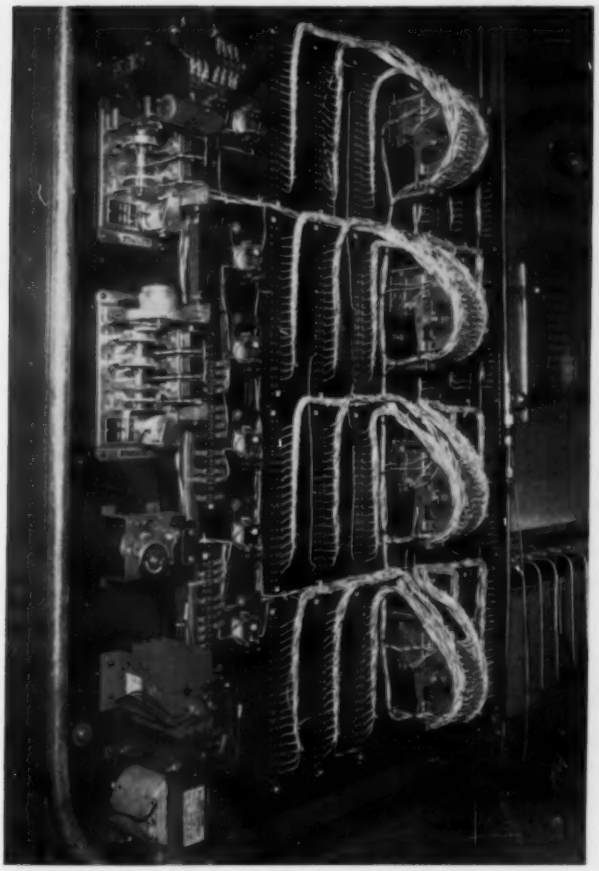
The specific pump for which the test facility was developed is a variable-delivery, axial-piston type. Basically it consists of a piston-type pump element and an externally-actuated servo system which is powered by an internal gear pump. The output volume and direction of flow are determined by the position of a tilt block against which the pistons ride. Position of the tilt block is controlled from an external source, through the pump's internal servo system.

The test facility consists of a basic flow circuit—a "closed loop" oil-circulating system; a shuttle valve test segment to test the pump's integral shuttle valves; an external set-up to control the pump stroke; the programmer-timer; and instrumentation.

• Closed Loop Flow Circuit—Let's trace the closed loop oil circulating system. The numbers in parenthesis refer to the hydraulic circuit diagram.

Starting at the "head" port of the test pump, we come first to a check valve network (1), which maintains the same direction of flow in the loop for any direction of flow from the pump. On either side of the network are high-pressure, high-temperature filters, to





PROGRAMMER-TIMER controls pump test cycle. The cycle can be varied by simple rewiring of this section.

protect the stand if the pump fails, and to protect the pump in case of test stand contamination or failure.

In the outlet line of the check valve network are high and low flow turbine-type meters (2), to cover the 0.3 to 15 gpm range. A manual signal or automatic signal from the programmer-timer will close the bypass diaphragm control valve which is in parallel with the low-flow meter, diverting the entire flow through this meter when rate is below 1 gpm. Above 1 gpm, the bypass valve is open and the high-rate meter measures the flow.

The discharge pressure control network (3) consists of three, normally open, diaphragm control valves (X,Y,Z) in parallel. Each is in series with a manually controlled orifice valve. The programmer-timer, by closing or opening the diaphragm valves in proper sequence, will expose the pump to different pressures.

To provide constant pump loading under the changing flow conditions encountered during two portions of the cycle set up for the pump we've been talking about, two legs of the pressure control network are supplied with 3:1 head-to-rod area ratio pistons. The pump flow is connected to the rod side and a nitrogen pressure source to the head side. With the nitrogen loading pressure and the downstream orifice valve properly set, pump flow that is greater than the orifice valve can handle will accumulate in the rod end of the loading piston. When the load is switched to the next portion of the cycle, the piston will unload itself of oil through the orifice valve into the main flow loop.

A nitrogen-buffered expansion tank (4), downstream of the orifice valve, absorbs the excess flow into the loop when the pistons unload, and supplies oil to the inlet of the test pump when the pistons absorbs oil from the loop.

The loop system includes two heat exchangers (5): a water-cooled exchanger for use primarily when tests are performed with fluid in the 75 F - 200 F range, and an air-cooled exchanger for higher operating temperatures, where the water coolant would steam and boil. The air-cooled heat exchanger, being smaller and easier to control, is used as a temperature trimmer at all temperatures. Both heat exchangers can be bypassed to permit the test pump's horsepower to enter the fluid and raise it to operating temperature faster.

To maintain and control oil temperature over changing flow and pressure conditions, the loop

expansion tank (4) is fitted with low-watt-density, 9 kw electric heaters. A high-temperature water-cooled pump circulates the oil continuously over the heaters at 15 gpm. This prevents burning and coking of the oil and prevents temperature stratification in the tank, assuring a constant oil inlet temperature to the test pump. A temperature-sensitive switch cycles the electric heaters on and off as required, keeping the fluid within two degrees of desired temperatures.

• **Shuttle Valve Test**—To simulate service operation and test operation of two integral pump shuttle valves, oil is bled from the closed loop through an outlet on the pump and from an outlet in the test stand piping. Both flows are measured: from the pump with a flowrator-type meter (6A), and from the piping with a turbine-type meter (6B). The flows are then drained into a sump (7), buffered with nitrogen at 5 psig. A transfer pump returns the oil from the sump to the nitrogen-pressurized replenishing tank or reservoir (8), which supplies makeup oil to replace fluid bled from the loop.

The reservoir, which has the same type of oil heating and circulation system as the expansion tank in the closed loop, maintains pump pressure and supercharges the pump inlet within an adjustable range of 70 psi to 150 psi.

• **Pump Stroke Control**—Four separate pump stroke control lever positions are required to program a test pump through the one-minute cycle specified for the unit.

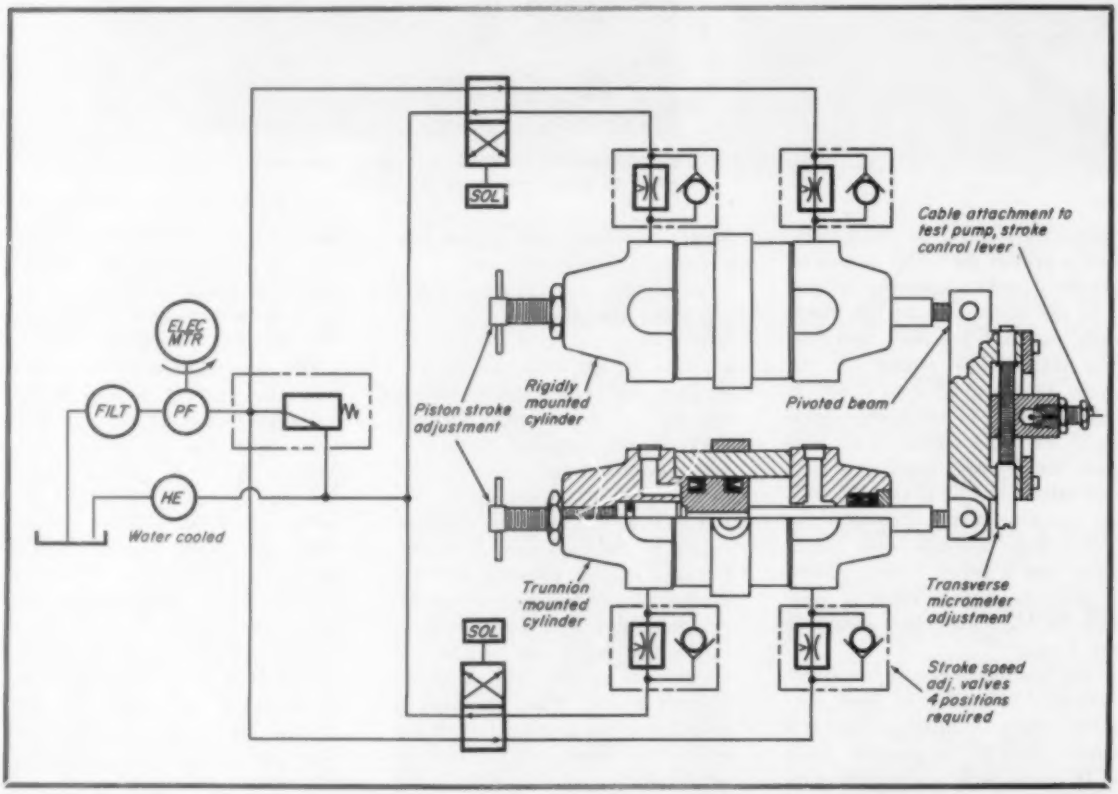
Two double-acting hydraulic pistons, with actuating rods connected through a pivoted beam, give the four positions. The cable connecting the beam to the pump stroke control lever can be positioned along the beam transversely to vary stroke positions. The two extreme positions are obtained when both piston rods are either fully extended or fully retracted; the two intermediate positions are obtained when one is extended and the other retracted, and vice versa.

The programmer-timer controls two four-way valves, which in turn control flow of hydraulic fluid to the rod side or head side of each stroke control piston.

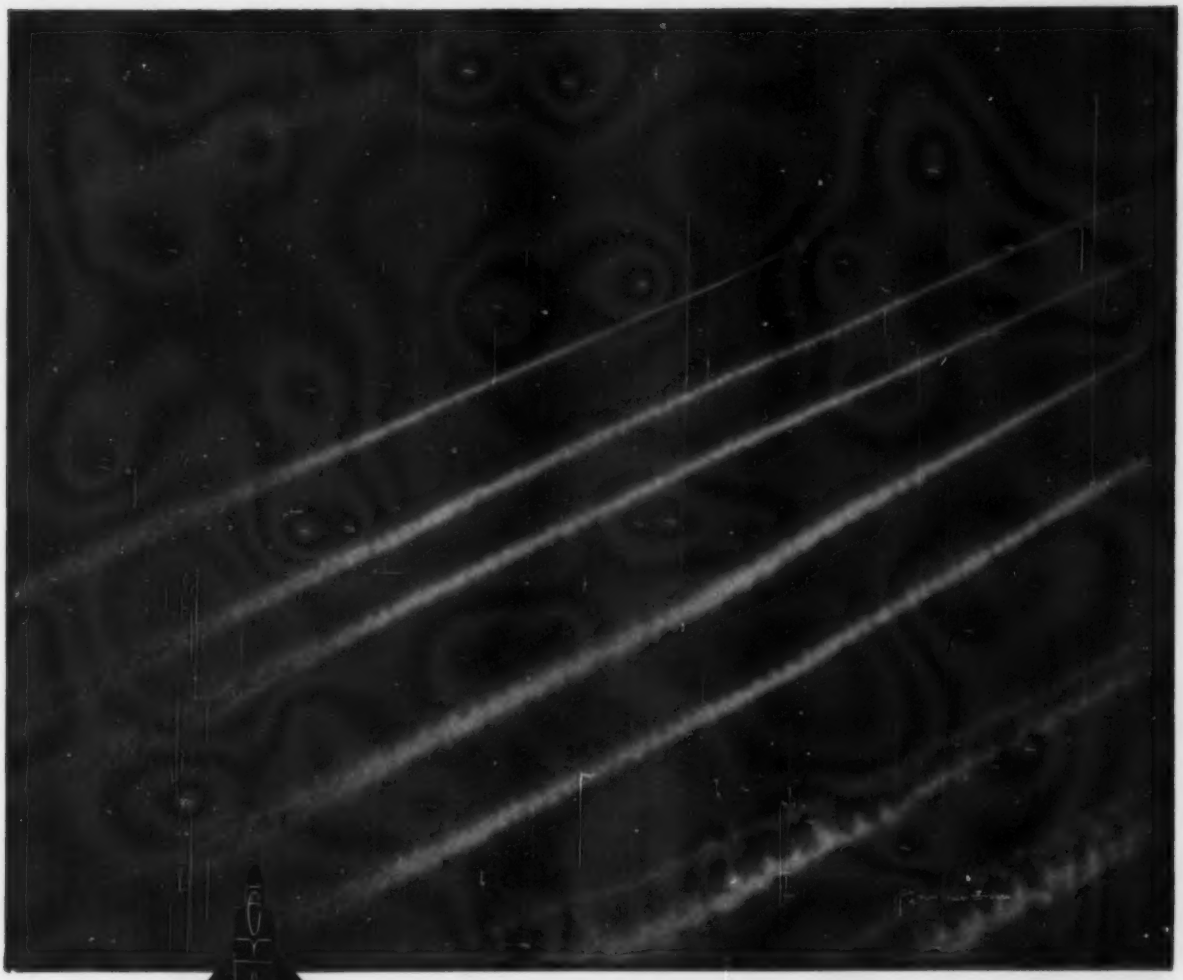
• **Instrumentation**—An oscillographic recorder constantly monitors pump speed, input torque, discharge flow, and bleed flow.

Since 14 recording channels are available, temperatures, pressures, and other functions can also be added to the recording set-up. But, except in special cases, tempera-

Continued on page 96



PUMP STROKE is controlled by this external circuit. Cable to the test pump's stroke control lever can be moved along pivoted beam attached to two double-acting hydraulic pistons, varying the stroke length. Whatever the cable attachment location, four different pump stroke lever locations are obtained.



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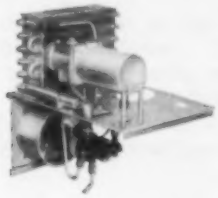

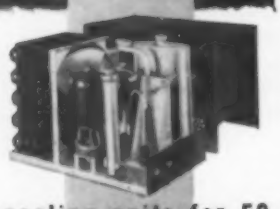

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PUMP TEST STAND

tures and pressures are monitored visually on a 24-station pushbutton pyrometer and pressure gages.

Speed and flow are shown visually on panel-mounted meters, in addition to being recorded oscillographically.

• **Component Selection**—The most important factor influencing the design of the test stand was the high operating temperature.

To withstand today's 600 F and tomorrow's possible 700 F requirements, we used type 347 stainless tubing and fittings throughout. Since 600 F fluid operating temperatures are not common as yet, much research and study was needed to find suitable components, such as check valves, flow meters, diaphragm valves, pistons and pumps.

Wherever we could, we tried to use standard items, but sometimes we had to design around components that were not readily obtainable. For instance, the initial design called for the pump replenishing pressure to be supplied by a gear-type pump with a bypassing relief valve. Since no suitable relief valve for 600 F was obtainable as a standard commercial item, we redesigned for the nitrogen pressurized reservoir.

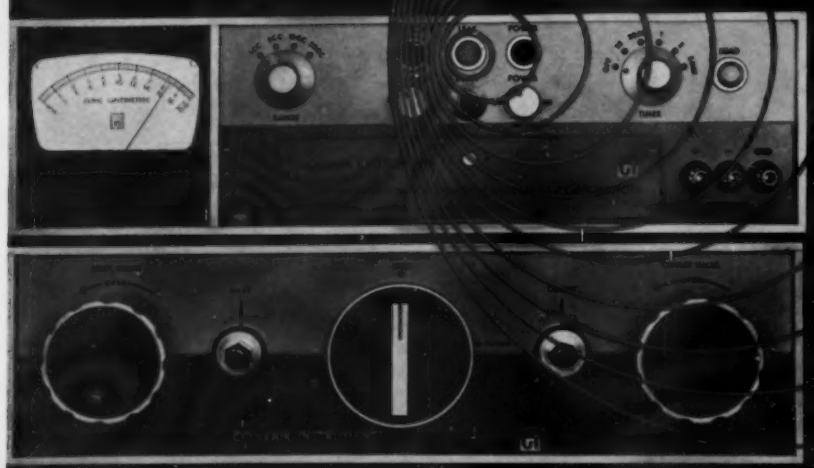
• **Safety**—Safety of operating personnel was a primary consideration in the design.

All high-temperature, high-pressure lines are in an enclosed, insulated portion of the main test stand enclosure. High-pressure valves that must be controlled by the operator are manipulated by extension handles at the control panel outside the test stand.

Each portion of the stand, including the test pump compartment, is serviced by a manually controlled CO_2 system to smother fires. Additional fire protection comes from the nitrogen buffering in all reservoirs; this not only lessens the fire hazard, but also prevents oxidation of the oil at high temperatures.

The entire test facility enclosure is equipped with an exhaust system to eliminate oil fumes. ▼▼▼

some leaks don't make drops



and the CI-LEAKMETER–NOW IN 3 MODELS, doesn't depend upon drop catching to measure hydraulic or fuel leakage!

A CI-LEAKMETER, *when installed in a line between a pressure source and the system or component under test, automatically detects and signals the existence of a leak. It automatically measures and indicates the amount of the leakage. A red light signals the presence of a leak –the amount of leakage is indicated on an electrical meter. The* LEAKMETER *incorporates a timer which can be set for test durations of 15 seconds to 5 minutes.*

Model No.	*Automatic Measurement Range*
Model 400	0.015cc to 80cc per minute
Model 410	0.0015cc to 8cc per minute
Model 420	0.00015cc to 0.8cc per minute

The LEAKMETER consists of an Hydraulic Assembly and an Electrical Assembly. These may be installed together, or at separate locations in the test area. Both are designed for rack mounting. Hydraulic connections are made by quick-disconnect fittings.

The LEAKMETER is compatible with all common hydraulic fluids and fuels. The item under test may be subjected to shock, vibration, or temperature, from which the LEAKMETER remains isolated. The instrument accommodates pressures to 5000 psi. Jacks are provided for recording or other readout.

For Complete Information–or to purchase a LEAKMETER *for Immediate Delivery, Write, Wire, or Phone:*

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ELECTROMECHANICAL AND MECHANICAL INSTRUMENTS; AC AND DC MEASURING DEVICES, TRANSDUCERS.

Ball valves permit compact flight actuator design

• By W. M. MORRISON, *Technical Director, Turner Mfg. Co., Ltd. Wolverhampton, England*

LIGHT weight, small size, no sticking or seizing, zero leakage, and easy modification. These desirable characteristics are achieved through an interesting design approach in a line of aircraft servocontrol actuators developed by French aircraft designer, René Leduc.

Instead of spools or slides, Leduc uses a ball valve arrangement to direct flow of hydraulic fluid in his actuators. The balls themselves are positioned by an axial distributor actuated by an axial piston rod. Both are inside the cylinder barrel.

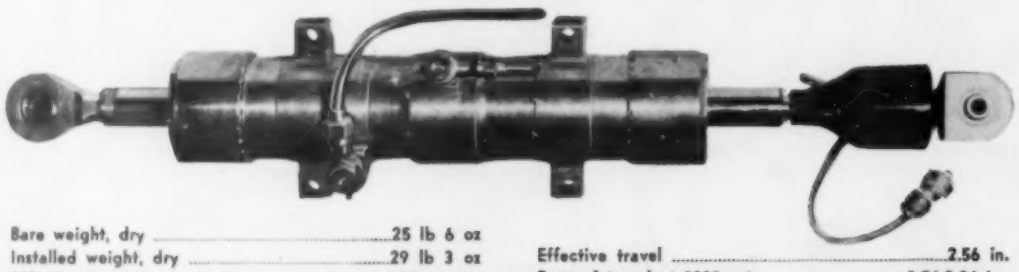
As a result, the actuator is very small, can readily be accommodated in thin wing sections, and can be linked very simply to flight controls.

If the main power supply fails, the balls seat and provide a perfect seal, with no leakage across the valve through the dead zone; there is also zero flow during steady flight. Since the valve uses only a very small amount of hydraulic fluid, control can be had from a standby accumulator for long periods.

The ball valve design also makes the actuator immune to effects of fluid pollution. Seizure and sticking in high-pressure operation are prevented by having adequate clearances, and by the use of non-extruding rubber-teflon packing between the cylinder and piston. The actuator's characteristics can be modified by changing the diameter of the balls.

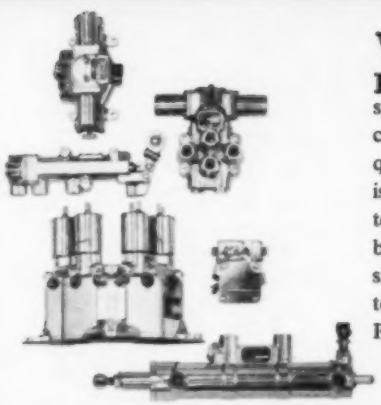
Leduc flight control actuators are installed in various French

Typical Leduc Servo-Control Aileron, Control Actuator for S.O. 4050 Vautour Fighter



Bare weight, dry	25 lb 6 oz
Installed weight, dry	29 lb 3 oz
Effective servo-piston area	2.32 sq. in.
Operating pressure	3000 psi
Force developed at 3000 psi	6950 lb
Maximum travel	2.75 ±.001 in.
Effective travel	2.56 in.
Rate of travel at 3000 psi	3.54-3.94 ips
Lost travel	.010-.013 in.
Total stroke control	188 ±.004 in.
Leakage back to reservoir at rest	Zero

Circle 4 →



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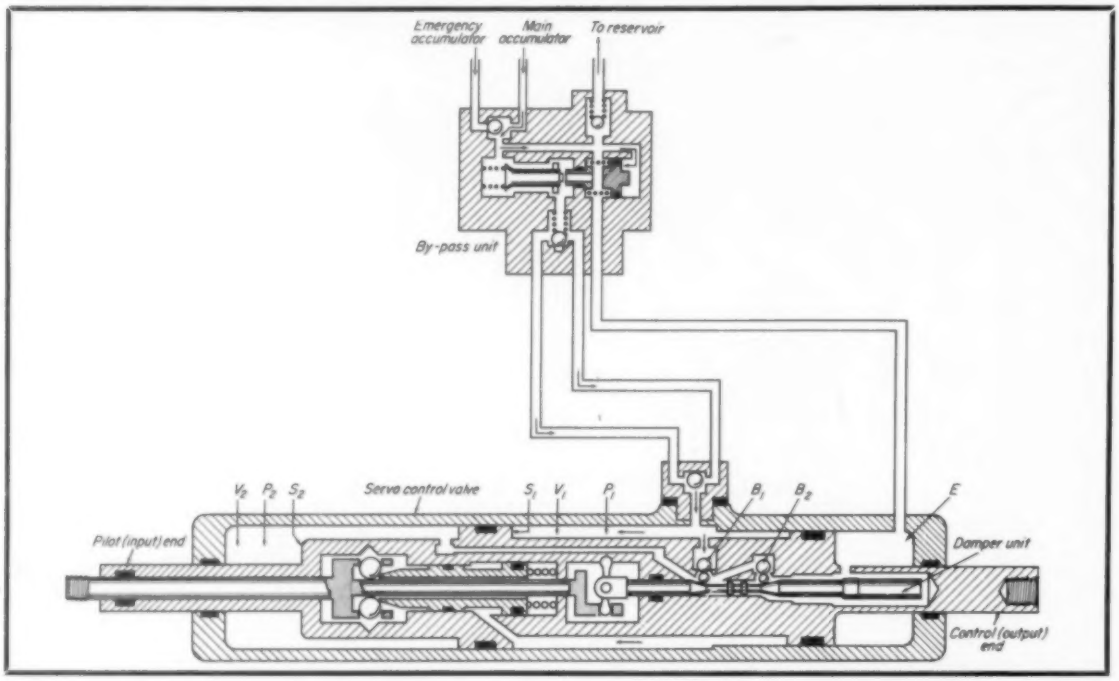
AIRCRAFT PRODUCTS CO.

BALL VALVES

planes, including Leduc's own experimental piggy-back ramjet, the Leduc 022, and in the Mystere, Vautour, Trident and Nordatlas. Various types are available, including hydraulic with manual reversion, hydraulic locking, and electrohydraulic. They can be operated from independent power sources or an accumulator. The actuators are made by Turner Manufacturing Co., Ltd., of Great Britain.

Here is how a typical Leduc actuator works:

HYDRAULIC OPERATION. Servo control at rest.



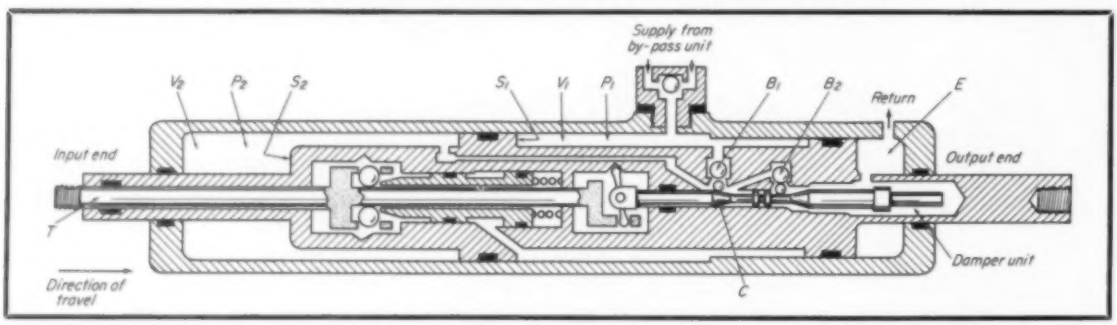
Pressure P_1, supplied by an accumulator or other energy source, through the bypass unit, acts continuously toward the left in chamber V_1 on servo piston area S_1.

This is balanced by the pressure P_2 of the locked-in fluid in chamber V_2, acting on effective area S_2; $S_2 = 2\ S_1$, so $P_2 = \frac{1}{2}\ P_1$.

Chambers V_1 and V_2 are interconnected through ball valve B_1, and chamber V_2 communicates through ball valve B_2 with chamber E leading back to the hydraulic reservoir.

However, in the rest position, ball valves B_1 and B_2 are held in the closed position by the pressures acting on them.

HYDRAULIC OPERATION. Inward movement of the control rod.

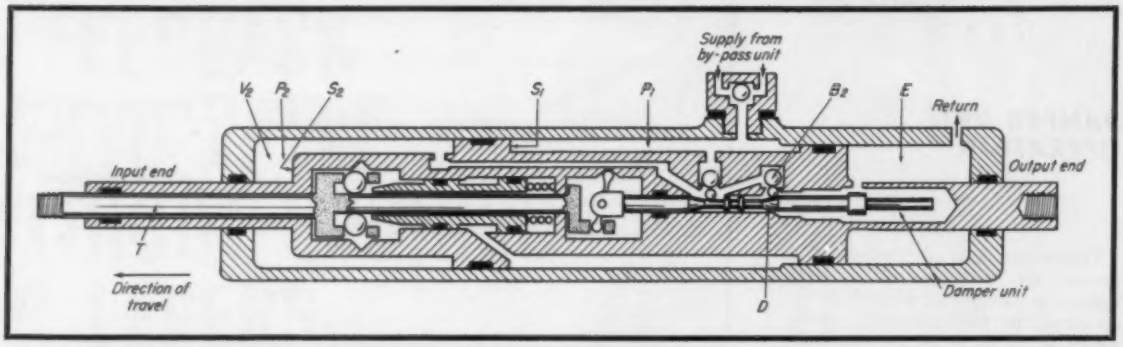


When the pilot causes the control rod T to move in (to the right), the tapered portion C of the distributor piston raises ball valve B_1 from its seat. This opens a shared fluid path to chambers V_1 and V_2, so pressures P_1 and P_2 become equal.

The forces applied to the servo-piston are now $(P_1 \times S_2)$ acting to the right and $(P_1 \times S_1)$ acting to the left. Substituting the value P_1 for P_2, and $2\ S_1$ for S_2, we see that the resultant is equal to $(P_1 \times S_1)$ acting to the right, and the piston moves to the right as the control rod did.

Movement of the servo piston forces fluid from chamber E to return to the reservoir. When the pilot stops acting on the control rod, ball valve B_1 closes and the forces on S_1 and S_2 again balance, and the piston comes to rest.

HYDRAULIC OPERATION. Outward movement of the control rod.

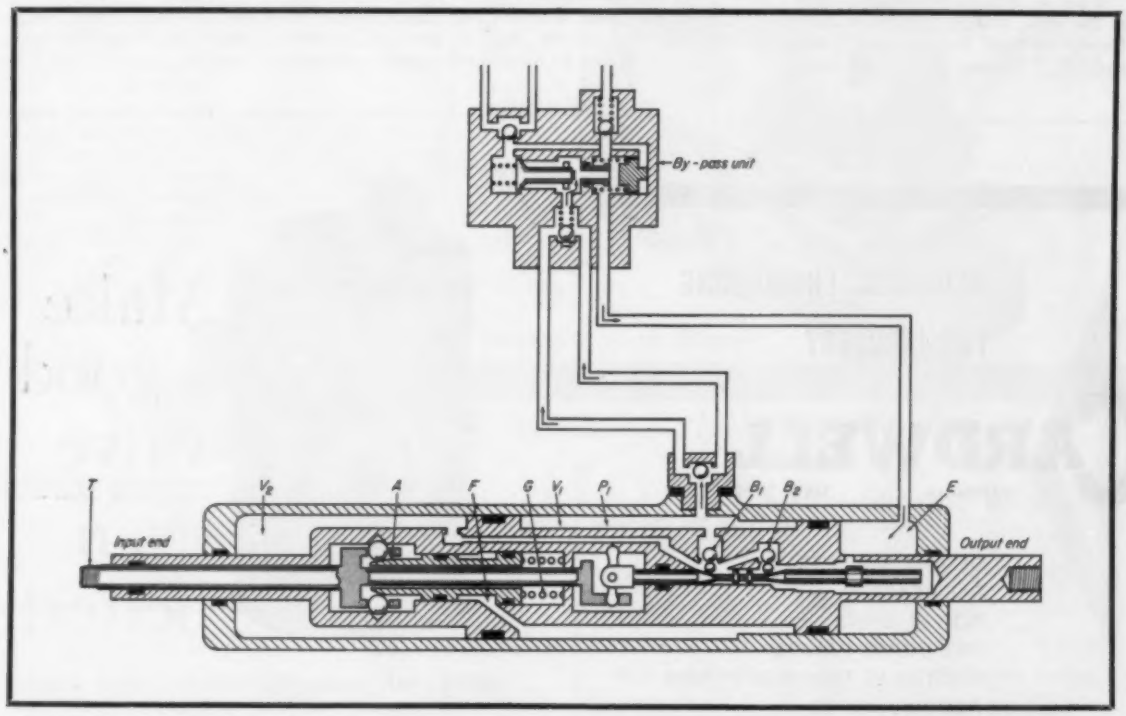


When the pilot causes control rod T to move out (to the left), the tapered portion D of the valve distributor raises ball valve B_2 off its seat, connecting chamber V_2 with the reservoir E. As this entirely relieves pressure P_2, the only force acting on the piston is (P_1 x S_1), to the left, and the piston again moves in the same direction as the control rod.

The forces causing servo-piston movement in either direction are of equal size, and the movement of the piston rod (control surface end) is equal to the movement of the control rod (pilot end).

Between the time one ball valve opens and the other closes, the distributor piston moves a certain distance with no effect on the servo piston. This lost distance can be adjusted by changing the diameters of the actuating balls.

MANUAL OPERATION. Hydraulic supply failure.



In the hydraulic operation condition, pressure P_1 acts on the flange of locking plunger F and compresses spring G. When the pressure falls to a predetermined level, the force of the compressed spring exceeds the pressure acting on the flange. This forces the locking plunger to the left and its tapered section A jams the locking balls into a V-groove, rigidly connecting the control rod T to the servo piston, so the two move as a unit.

Now, when control rod T is pulled out (to the left), the fluid in chamber V_2 is forced into chamber V_1 through ball valve B_1 (ball valve B_2 being closed), then through external lines to the bypass unit, and back to chamber E. The fluid circulates in a closed circuit, as indicated by the arrows.

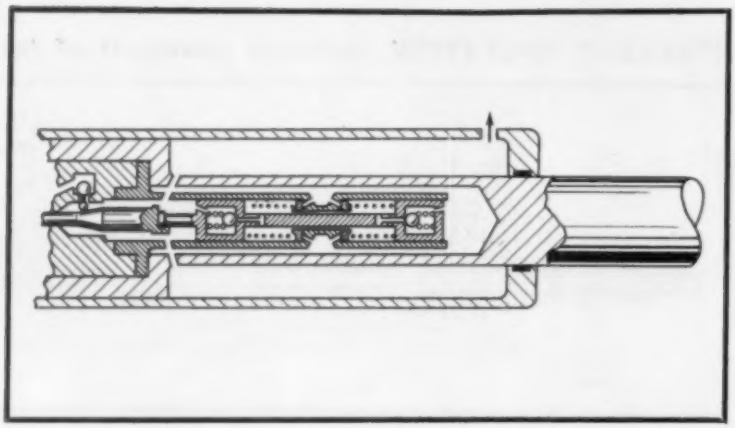
When the control rod is moved in, the fluid in chamber V_1 is expelled in the lines leading to the bypass unit, from which it returns to chamber E. At the same time, the fluid in chamber E is forced into chamber V_2 through ball valve B_2 (B_1 being closed).

As soon as the hydraulic pressure returns, pressure P_1 pushes locking plunger F to the right, unlocking the piston from the control rod, and normal hydraulic operation resumes immediately.

Continued on next page

BALL VALVES

DAMPER UNIT OPERATION



Fluid returning to the reservoir after leaving the distributor first flows through an integral damper unit in the actuator. The fluid pressure is maintained at 21 to 28 psi by the check valve in the bypass unit.

Due to this low pressure, the fluid is admitted into the front and rear chambers 1 and 2, of the damper unit through ports 3 and 4, past valves 5 and 6. When the damper is full of fluid, the pressure in chambers 1 and 2 equals the pressure of the fluid returning to the reservoir, and ports 3 and 4 are sealed off by valves 5 and 6, which are forced to close by springs.

When the distributor piston is pushed to the right, plunger 7 moves with it, forcing the fluid from chamber 1 into chamber 2 through the annular clearance between link-rod 8 and the bore of the restricted portion 9 of the damper body, retarding the distributor piston (valve 5 seals part 3, so the fluid cannot be relieved here).

When the distributor piston is pulled outward, the action is similar but in the opposite direction.

When the piston is moved very fast, let's say outward, the fluid in rear chamber 2 cannot be transferred into the front chamber 1 fast enough. The excessive pressure that builds up in chamber 2 and oilway 12 causes ball valve 11 to open against its spring 10, and the fluid returns to the reservoir through port 13. At the same time, the negative pressure in chamber 1 causes fluid to be sucked in through valve 5 to replace fluid that has escaped from chamber 2, equalizing the pressures in chambers 1 and 2. ▼▼▼

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HADBAR bonded fluorosilicones improve component reliability in missile check-out systems. The bonded seal on this valve is resistant to fuels, nitrogen and helium...is compatible with LOX cleaning methods...functions in a temperature range of −80°F to +300°F. HADBAR may have the answer to your specific requirements in molded, extruded and bonded applications.

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Circle **52** on Time-Saver Card

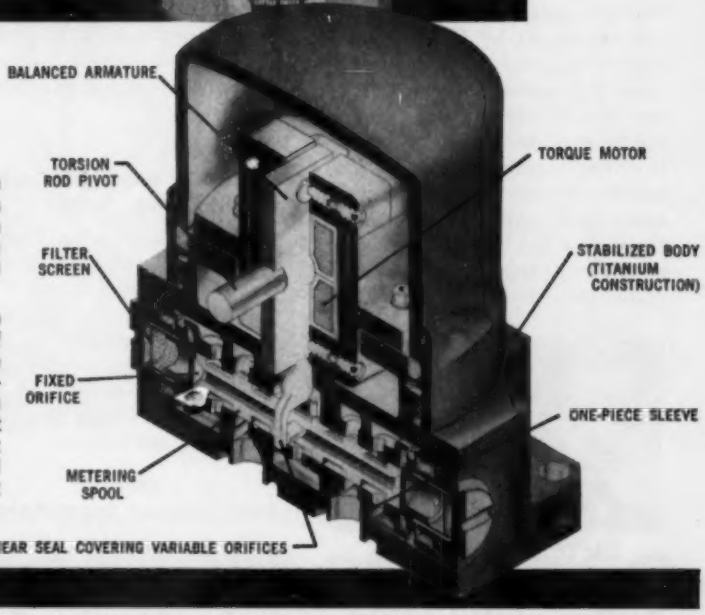
NOW IN PRODUCTION

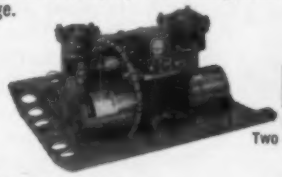
A FEEDBACK SERVO VALVE WITHOUT SPRINGS OR LEVERS

- *Unity coupled Hydromechanical Feedback*
- *High Null Accuracy*
- *Only 2 moving parts*
- *Large, full opening, shear-seal orifices*

This two-stage, four-way flow control valve is the only one available that provides true positional feedback without springs or levers. The first stage consists of an electrical torque motor and "shear-seal" orifice hydraulic amplifier, while the second or control stage is made up of an accurately matched spool and sleeve arrangement.

Hydromechanical unity feedback relates spool position to torque motor armature position and also nulls out effects of orifice variations due to supply pressure and temperature fluctuations. Flow force reactions are thus substantially reduced and hydraulic centering of pilot position is feasible without spring hysteresis and null shift. Large orifices prevent clogging and silting and high shear forces permit efficient operation even with highly contaminated fluids. Final null adjustments are made electrically by a balancing control at amplifier output stage.





Integrated Control Module Includes Kearfott's Electrohydraulic Servo Valve, Two Rotary Output Shafts, Geared Pump and Pressurized Sump.

TYPICAL CHARACTERISTICS

	Medium Flow (#6103-#6106)	High Flow (#6104)
Rated flow	to 7.5 gpm at 3000 psi valve pressure drop	to 18.0 gpm at 3000 psi valve pressure drop
Hysteresis	3% maximum total rated current	3% maximum total rated current
Supply pressure	300 to 3000 psi	300 to 4000 psi
Proof pressure	4500 psi pressure port 3000 psi return port	6000 psi pressure port 3000 psi return port
Pressure gain	First stage—500 psi per ma minimum with 3000 psi supply	First stage—500 psi per ma minimum with 3000 psi supply
Load pressure gain	8500 psi per ma minimum with 3000 psi supply	10,000 psi per ma minimum with 3000 psi supply
Temperature	−65°F to +275°F	−65°F to +275°F

	Medium Flow (#6103-#6106)	High Flow (#6104)
Maximum Null Shift Temperature Change per 100°F	(% of rated current) 1%	1%
Supply Pressure Variation ±	2%	2%
Quiescent Current Change 20%	1%	1%
Weight	12 ounces	16 ounces

TORQUE MOTOR: Note: 6103 & 6106 Identical with exception of torque motor characteristics.

	Valve #6103	Valve #6106
Input Power	300 Milliwatts	64 Milliwatts
Rated Current	± 10 ma	± 8 ma
DC Coil Resistance (other motors also available)	3000 ohms/coil	1000 ohms/coil

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AVIATION NEWS

from the fluid power field

Vickers names application engineer

Appointment of L. J. (Jack) Findley as application engineer was announced by W. L. Stone, western regional sales manager, Aero Hydraulics Division, Vickers, Inc. Findley's headquarters will be at Vickers' western regional office, Torrance, Calif. He has had broad experience in aircraft and missile engineering including analysis on the Thor GSE, design of aircraft engine installations, preliminary design of the C-133.

Findley

Norton

Norton becomes Weatherhead chief engineer

Announcement of J. Frederick Norton as chief engineer, valves, was made by Louis B. Courtot, director of engineering, The Weatherhead Co., Cleveland, Ohio. Norton will supervise product design and engineering of all aviation valves and quick-disconnect couplings for the company's Aviation and Missile Division. He has been responsible for design and development of hydraulic and pneumatic valves for the military services, and for special processing machinery.

Niemela to manage Airsupply-Aero office

Raymond J. Niemela will manage the Mineola, N. Y. branch office of Airsupply-Aero Engineering Co., Div. Garrett Corp., Los Angeles. He has been with the firm for nearly ten years. Niemela replaces A. O. Schmitt, now Mineola branch manager of the parent corporation's sales organization.

Maron to head GSE sales for REF Mfg. Corp.

REF Manufacturing Corp. has appointed Harold Maron as Supervisor of Sales, Ground Support Equipment. He will help develop equipment for testing aircraft and will guide engineering applications. A portable hydraulic power supply system is being developed by the company.

Lear licenses Lucas-Rotax

Pumps and check valves developed by Lear, Inc., Elyria, Ohio will be manufactured in Canada by Lucas-Rotax, Ltd., Toronto. This is part of a Lear program of licensing agreements with established companies throughout the free world. Lucas-Rotax manufactures fuel pumps for the Canadian aircraft industry. Lear lubrication and scavenge pumps to be built in Canada under the new agreement will be used initially for the GE-J-79 engine. Lear eventually may produce some Lucas-Rotax products under license in the US.

Cornelius makes changes in sales staff

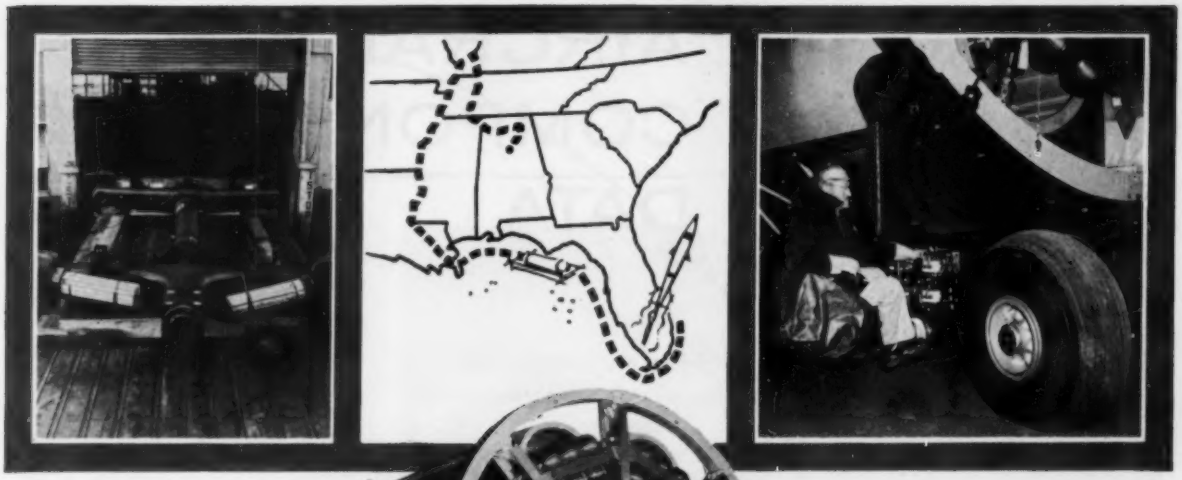
Joseph W. Mahanay, sales manager, The Cornelius Co., Aero Division, Minneapolis, Minn., announced the following changes in his sales staff. L. John Buyee, West Coast field engineer, has been promoted to the newly created position of assistant sales manager. In addition to his new duties he will continue to serve the West Coast territory. J. Robert York, who had been Midwest sales engineer for the last two years, has been transferred to the East Coast territory. Succeeding York in the Midwest is George Krause. Appointed to the newly created post of senior field service representative is Ray Swanson, who preceded York as East Coast sales engineer.

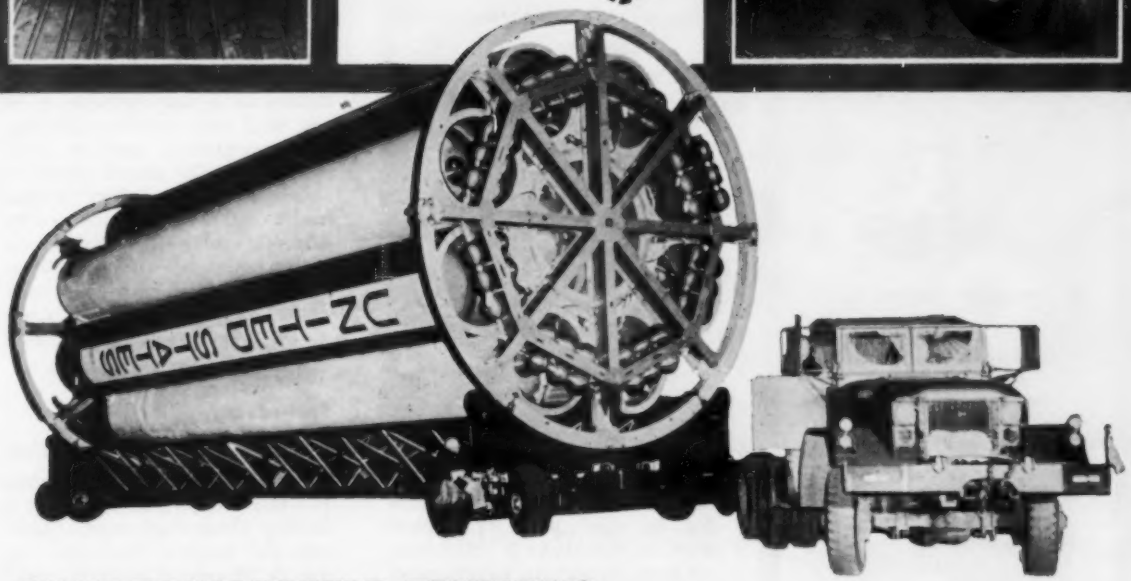
Space and missile testing lab

Large quantities of pneumatic, hydraulic, and electronic environmental testing equipment will go into a new space and missile testing facility at Orlando, Florida. This unit of Associated Testing Laboratories, Inc., Caldwell, N. J., will perform reliability and environmental tests on parts which The Martin Co. produces for missiles. Associated will also serve other prime and sub-contractors. By the end of 1960 over 100 technical specialists will be assigned to the laboratory, which contains over 10,000 sq ft. It is one of the largest in the South.

Marquardt appoints technical director

Royal V. Keeran, former vice-president and general manager of Brubaker Electronics, Inc., has been made technical director at the Pomona Division of The Marquardt Corporation. Keeran is a veteran of 20 years in electronics engineering and management.





GIANT TRANSPORTER FEATURING ACIPCO "WALKING BEAM ASSEMBLIES" WILL HELP...

Saturn's conquest of space

The moment draws near when America's Saturn rocket will thunder into space. But in the meantime, elaborate ground preparations are now taking place.

From the N.A.S.A. Marshall Space Flight Center in Huntsville, Alabama, via a circuitous land and water route to the launching site, the missile and its valuable cargo will be gently cradled on the huge transporter shown here. Acipco walking beam assemblies (upper left) are vital parts of this transporter.

These rugged assemblies are constructed of high strength alloy steel and comprise centrifugally spun and statically cast component parts . . . all produced at Acipco. Also, all precision machining and intricate fabrication work were done by skilled Acipco personnel.

While your tubular product application may not be destined for outer space, Acipco's production "know how" and complete "under one roof" facilities can assist you, too. Your inquiry is invited.

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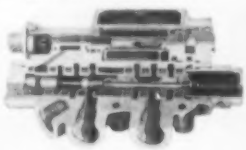
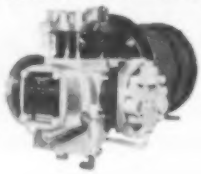
First, imaginative design; then experienced thoroughness through development, tooling, production, assembly and tests, all under strict quality control in an unusually well equipped plant . . . we can help you solve your special problems . . .

- BRAKE VALVES
- TRANSFER VALVES



- RELIEF VALVES

- COMPACT COMPRESSORS



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Circle **76** on Time-Saver Card

AIRCRAFT COMPONENT DATA

6000-PSI Metering Valve
. . . replaces three valves

Valve may be used as 3-port valve with two ports in common, as globe valve, or as angle valve. O-ring seal plug closes off one port

when valve used as globe or angle valve. Install relief valve or burst disc in third port for thermal safety or pressure-surge relief without extra piping. All stainless steel. Weighs 1.06 lb. 3/16″-dia flow passage. Low operating torque. For —65 to 250 F. Can be panel-mounted in 30 sec.—*Robbins Aviation, Inc., North Hollywood, Calif.*

Circle **500** on Time-Saver Card

Pressure Switches
. . . are adjustable

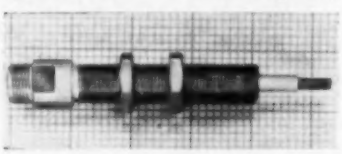
To change actuation points, remove plug, and adjust splined screw. Nine models cover 2 to 3000 psig. High-pressure diaphragm sensing

element eliminates seal friction. Series 6657 switches operate in ambient temperatures from —65 to 275 F. Accuracies within 2% below 165 F, within 5% above 165 F. For air, gas, oil, fuel. Meet vibration requirements of MIL-E-5272, Procedure I, extended to 2000 cps. Shocks to 100 g's don't affect operation. One or two spdt switches. Contact ratings are 2½ amp inductive or 5 amp resistive at 30 vdc, or 5 amp at 125 or 250 vac. Standard pressure port is 7/16″ male fitting, 20 thread. Anodized aluminum and Teflon contact media. 50,000 cycles guaranteed below 500 psig; 30,000 cycles, at higher pressures. Weigh 10 oz. 1¾″ dia x 5½″ length.—*Consolidated Controls Corp., Bethel, Conn.*

Circle **501** on Time-Saver Card

Transducer
. . . in three sizes

Variable differential transformer provides proportional ac output in sensing linear displacement. Measures and controls. Excitation voltage is 10 vrms. Carrier frequency



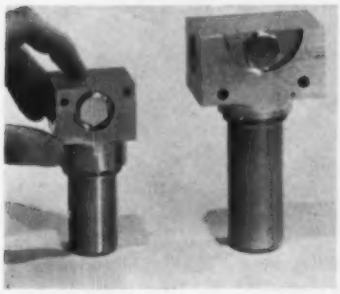
is 400 cps to 3 kc. Type H101A operates consistently from —65 to 250 F, under rapid environmental changes. 1″-4″ linear ranges. Nonlinearity is 0.5% or less. Resolution is continuous. Repeatability is 0.01% or better. Sensitivities in millivolts output per input volt per .001″ are 1.0 to 0.25, when operated from 1 kc carrier. Made of stainless steel, encapsulated with epoxy resin. Threaded housing with locknuts. Unit can be mounted, rotated to null point, and secured by locknut.—*Pacific ElectroKinetics, Glendora, Calif.*

Circle **502** on Time-Saver Card

Airborne Hydraulic Filters
. . . for high pressure

Rated at 3.5 and 10 gpm. Nominal rating is 10 microns. Elements

made from pleated, resin-impregnated, cellulose-fiber sheet. Both have pressure drop of 30 psig using MIL-H-5606 fluid at 100 ± 10 F. Temperature ratings from —65 to 275 F. Heads and bowls machined



from aluminum bar stock. Rated operating pressure is 3000 psi. Rated impulse burst pressure is 7500 psi. Weigh 0.7 and 1.3 lb. Can filter gases and other liquids. *—Bendix Filter Div., Bendix Corp., Madison Heights, Mich.*

Circle **503** on Time-Saver Card

Pipe & Tubing

. . . resist corrosion

Weld is completely wrought through cold rock-forging. In sizes from 2½" to 4" IPS. For high temperatures, pressures, and corrosion. A 70 F, stainless FFR is 15%-20% stronger than seamless. At 1400 F, it's 30%-40% stronger.*—Swepco Tube Corp., Clifton, N. J.*

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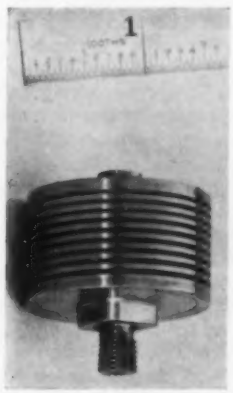
. . . regulates LOX pressure

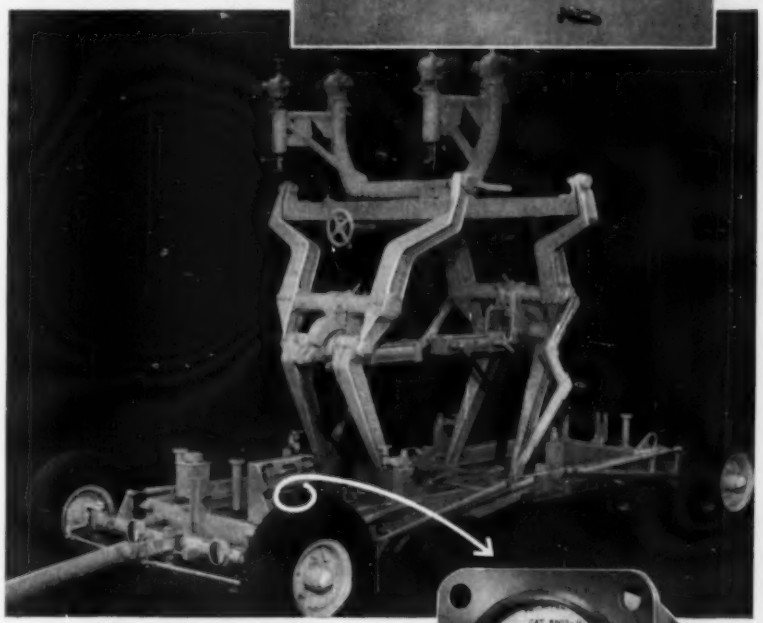
Suitable for other applications. Fully machined. For 100-psi max

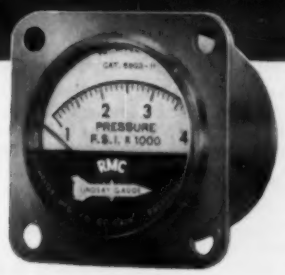


pressure differential. Temperature range is —450 to 1000 F. In aluminum, stainless steel, nickel alloys,

Continued on page 108

At the right a McDonald *Green Quail* Missile is being launched from a B-47. The *Green Quail* ground support trailer is shown below.





Trailer mounted RMC-Lindsay pressure gauges give fast, dependable systems check for unerring flight of Green Quail

Fast, because they are designed for maximum readability and quick response. Dependable, because of their simple direct-drive operation and precise construction.

The RMC-Lindsay gauge is completely different from the usual pressure gauge. Instead of the common "C" type bourdon tube, the RMC pressure element is a helical bourdon coil which offers greater resiliency and longer accurate cycling life. Instead of the pointer being actuated through the usual linkages, gears, hair springs and the like, the RMC pointer is attached directly to the end of the helical bourdon pressure element. This eliminates waver and lag, wear and slippage; provides exceptional resistance to the destructive effects of vibration, shock and pulsating pressures.

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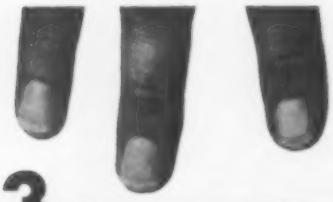

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To service a Robbins Metering & Shut-Off Valve it is only necessary to remove the handle, loosen locknut and remove barrel assembly . . . all accomplished from the front of the panel . . . no need to disturb the line connections!

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3. **As many as 5000 cycles before requiring servicing!**

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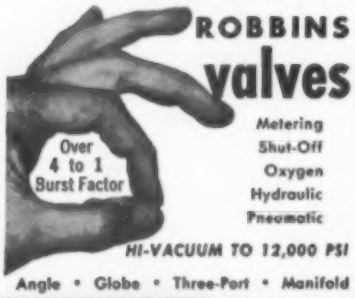

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AIRCRAFT COMPONENT DATA

and other materials. Hysteresis is almost zero. Has withstood over 10 million cycles without metal fatigue. Wall thickness is precisely controlled. Infinite range of diameters and strokes.—*Hydrodyne Corp., North Hollywood, Calif.*

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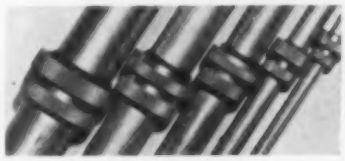
Flexible Couplings for Tubes . . . need no beads or flares

Low weight-to-strength ratio. No-leakage seal. Pass MIL-C-25104. Couplings attached to tubing by

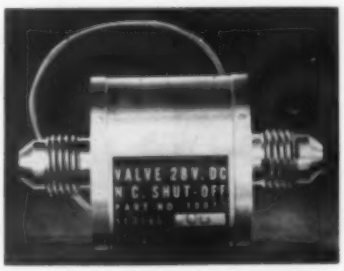


swaging. Fittings become part of tubing. ¼" axial motion, 8 deg angular flexibility. For —70 to 450 F. Sizes ⅜" to 5".—*Gamah Corp., Santa Monica, Calif.*

Circle **506** on Time-Saver Card

¼" Solenoid Valve . . . uses 28 vdc

For air, oil, and fuel. Operates at 150 psi. Modified, operates to 500



psi. No elastomers. Low leakage. One moving part. Stainless steel valve has straight-through flow path. Variety of port configurations. Weighs less than 5 oz.—*On Mark Couplings, Inc., Los Angeles, Calif.*

Circle **507** on Time-Saver Card

Dual-Coil Pneumatic Valve . . . is magnetically controlled

Designed primarily for control of nose-cone attitude in outer space. Model MV-162 provides 300-psig air to two reaction nozzles for control of pitch, yaw, and roll. 3-way, 3-position. Zero leakage. Operation time is .025 sec.

With forged aluminum body, valve weighs 1.7 lb. Two pressure-sensing ports for indication of valve position. Two 24-vdc coils rated for continuous duty.—*Marotta Valve Corp., Boonton, N. J.*

Circle **508** on Time-Saver Card

Venturi-Type Valve . . . is direct-acting

Shut-off model V-20000-04. Venturi and optically-flat, floating seal

insure straight-through flow path without obstructions. Venturi's pressure-recovery characteristics allow reduction of fluid-line ID. This permits light, direct-acting solenoid. Self-lapping, floating-seal disc is self-cleaning, withstands normal contaminants and foreign matter. Teflon, silicone, and glass insulation. Mechanical and thermal shock don't affect coils. Coils maintain dielectric strength under salt spray and temperatures to 500 F. Valve and solenoid rating is 0-225 psi. Ambient temperature range is —65 to 250 F. Fluid temperature range from —30 to 350 F, (to 550 for 10 minutes). Valve adapts to any type of fitting. In 1" line size. Weighs 1¾ lb.—*Valcor Engineering Corp., Kenilworth, N. J.*

Circle **509** on Time-Saver Card

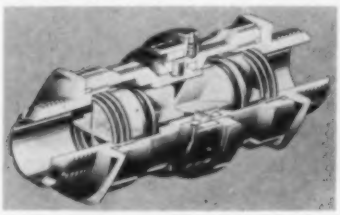
Leak Detector
. . . mass-spectrometer type

Electronic circuits are mounted on tilt-down chassis module, which exposes all circuits. Vacuum system removes from cabinet in less than five minutes. Diatron can be removed without shutting down or venting rest of vacuum system. Baffle of the stainless-steel, vacuum system minimizes migration of oil from vacuum pumps. Interchangeable pumping-speed-control chokes. Three-liter cold trap needs filling only once in 24 hours. Weighs 200 lb. Measures 30" x 20" x 20". Matching cart available. Requires 105 to 125 v, 60 cps. Operates in ambient temperature of 40 to 110 F, relative humidity to 95%. Sensitivity is 1 part helium in 10 million parts air. Double-valve, fast-response inlet manifold. Operates on principle of mass spectrometer focused on helium. Analyzer measures tracer gas which leaks through part. Attentuations of x1, x5, x10, x50, x100, x500, x1000, and off. 24-025 test port station can be used with 24-120 leak detector for fast production testing of small parts.—*Analytical & Control Div. Consolidated Electrodynamics Corp., Subs. Bell & Howell Co., Pasadena, Calif.*

Circle **510** on Time-Saver Card

Quick-Connect Couplings
. . . sizes from 1/4" to 3"

Handle fluids ranging from air to exotic fuels. Large bearing surface contact of locking pins in nipple groove and socket body. Area and technique of contact eliminate brinneling, assure better sealing. As collar assembly is turned in lock direction, locking pins move along socket's activating cam ring, and deeper into corresponding groove in nipple. This continues until rounded head of



indicating pin seats into flat-bottom, locked position hole. Seating secures and aligns coupling. Springloaded indicating pin snaps in and out of flat-bottom hole. Coupling clicks as indicating pin seats. When collar turns the other way, coupling disconnects "Star" poppets provide least restriction of flow. Pressure drop through 1" coupling is less than 3.1" H_2O at 6 gpm. Special designs have no size limit. Materials include aluminum, stainless steel, carbon steel, and plastic.—*Jack & Heintz., Inc, Cleveland, Ohio.*

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. . . for use with helium

Operating pressure inlet: 100 to 20,000 psi. Regulated pressure,

using domeloading principle, is adjustable from 100 to 20,000 psi. Proof pressure is 40,000 psi. Flow rate to 100 lb./min. helium with 6000 to 10,000-psi inlet pressure. No. A90089.—*Vinson Engineering & Sales Co., Van Nuys, Calif.*

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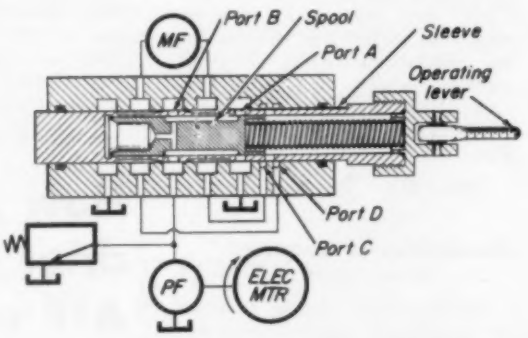
FLUID POWER PATENTS

Directional Valve With Built-in Flow Control Valve

Valve output is adjustable from zero to full capacity. It maintains a set output regardless of pressure fluctuations at its pump or outlet ports.

In the neutral position shown, pump output flows through ports in the valve body, sleeve, and spool, into the chamber at the left end of the spool. As the spool moves right, port *A* opens and relieves excess fluid back to the tank. In this position, the valve maintains a pressure corresponding to the spring force.

When the operating lever moves the sleeve assembly left, an orifice opens at *B*. The distance the sleeve assembly moves determines the size of the orifice. Pump



output flows through the orifice to the right side of the fluid motor. Fluid from the left side of the fluid motor flows through the valve to tank.

When the spool moves left, port *C* opens to the spring chamber and exposes the right end of the spool to the pressure on the downstream side of the orifice. The left end of the spool is influenced by pressure upstream of the orifice. Therefore, pressure drop across the orifice is governed by spring force which is essentially constant.

When the operating lever moves right, port *D* opens to the spring chamber, and the controlled flow to the fluid motor reverses.

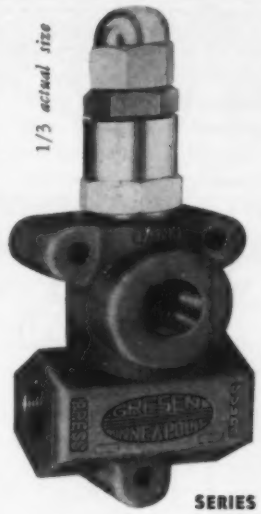
U. S. Patent No. 2888,943 by George M. Hipple, assigned to American Brake Shoe Co., Columbus, Ohio

Press Speed Control Circuit

The circuit slows the press piston as it approaches the work, and returns it to full speed when pressing begins. Its primary use is on welding presses where

Continued on page 112

Circle **51** on Time-Saver Card



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ONLY $16.50*

SERIES PJ (*pilot operated*) **$19.50**

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FOR EXTRA TOUGH APPLICATIONS!

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- Sheffer pioneered tapered cushion piston decelerates motion gradually, minimizing "cushion entrance" shock.
- Multi-lip rod packing is self-adjusting to wear and removable without disassembly of cylinder.
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- Full range of bore sizes, 2"-12". Nine mountings!

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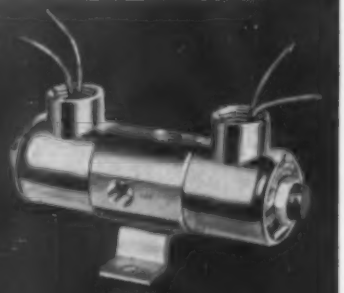

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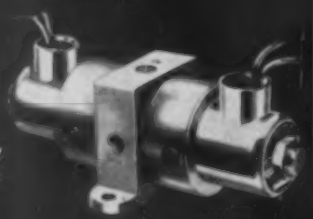

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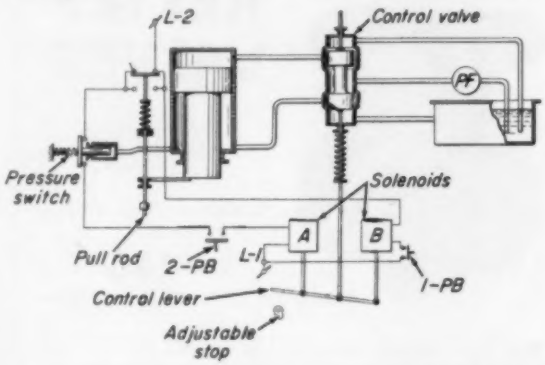
FLUID POWER PATENTS

full pressure and flow are needed immediately after the work is contacted.

The press cycle starts when maintained contact push-buttons 1-*PB* and 2-*PB* are pressed, energizing solenoids *A* and *B*. The control valve shifts, extending the press piston at full speed. Cushioning begins when the



actuator attached to the press ram hits the stop on the pull rod and opens the top contacts. Solenoid *A* de-energizes and the control lever extends until it rests on the adjustable stop. The control valve spool partially shifts and meters fluid out from under the press piston. Increased pressure under the piston opens the pressure switch contacts, assuring that the circuit to solenoid *A* remains open as long as there is pressure under the press piston.

When the press meets the work, pressure under the piston drops and the pressure switch closes. With the pull rod lower contacts closed, Solenoid *A* is energized and the control valve opens full, allowing full pump flow to the press ram.

When pressing is complete, 1-*PB* and 2-*PB* are released. Solenoids *A* and *B* de-energize shifting the control valve to retract the press piston.

U. S. Patent No. 2,846,980 by Milan Vltavsky, Bratislava Czechoslovakia.

Other Patents Issued

VARIABLE CAPACITY PUMP

U. S. Patent No. 2,907,279 by Emile J. Carleton, assigned to Hydraulic Engineering Co., West Springfield, Mass.

FLUID CONTROL VALVE

U. S. Patent No. 2,908,291 by Nathan C. Hunt, assigned to Hunt Valve Co., Salem, Ohio.

FLUID PRESSURE AMPLIFIER

U. S. Patent No. 2,909,035 by Robert E. Mitton, assigned to Hydraflex Corp., Dallas, Texas.

PRESSURE FOLLOW-UP SERVOMOTOR

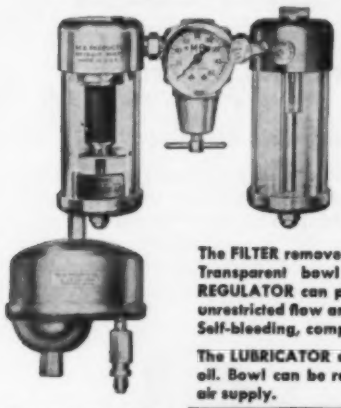
U. S. Patent No. 2,909,156 by Rene Leduc, Argenteuil, France.

Circle **75** on Time-Saver Card

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



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The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

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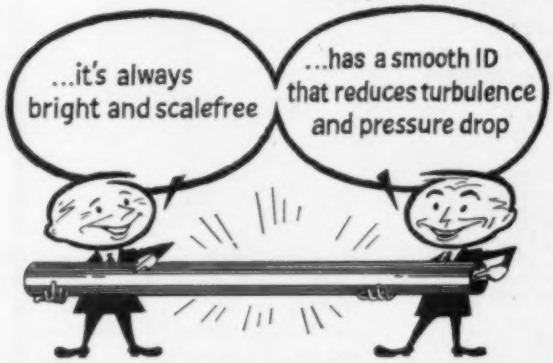

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- *100% hydrostatic testing* to recommended working pressures
- *Rust preventive treatment* of all tubing before shipment
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- *A complete range of sizes* stocked by leading steel service centers

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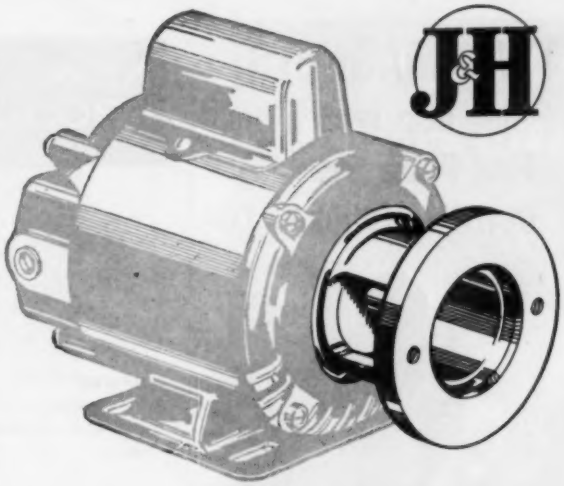

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5000 psi working pressure . . . 12 gpm flow capacity . . . 15 lbs dry weight . . . for ¾" taper pipe, NPTF; also ¾" tube connection. Spec. AND-10050. Others rated at 2000 psi; Capacities up to 40 gpm.

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P. O. Box 1138 Trenton 6, N. J.

Circle **45** on Time-Saver Card

NEW PRODUCTS

Continued from page 60

IN-LINE RELIEF VALVE . . . is light, compact

Designation: Series FRV

Features: Valve is smooth, quiet, and chatterproof. Made of aluminum and stainless steel. Aircraft quality.

Specifications: Zero leakage to within 95% of cracking pressure. Externally adjustable from 20 to 2000 psi. Stocked in ¼-⅜ and ½ male pipe and male tube sizes.

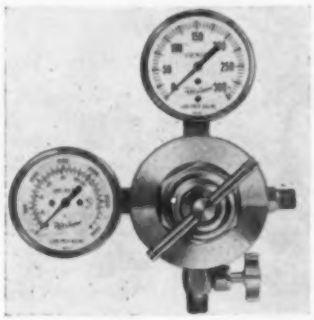
Fisher Controls, Inc.
Santa Monica, Calif.

Circle **312** on Time-Saver Card

PRESSURE REGULATOR . . . for corrosive fluids, corrosive atmospheres

Designation: 640 Series

Features: No flaking or eventual destruction. 316 stainless steel or



monel wetted parts. Other parts are 18-8 stainless. Teflon seat and diaphragm. Kel-F seating disc and O-ring seals.

Specifications: Maximum inlet pressure is 2000 psig. Delivery pressures to 125 psig.

Hoke, Inc.
Cresskill, N. J.

Circle **313** on Time-Saver Card

VITON O-RINGS . . . for low temperatures

Designation: V500-6

Features: Have Viton's toughness, resiliency, and dependability.

Specifications: Still flexible at temperatures well below −100 F. Perform well in all hydraulic fluids and oils through 400 to 500 F.

Parker Seal Co.
Div. Parker-Hannifin Corp.
Culver City, Calif. & Cleveland, Ohio

Circle **314** on Time-Saver Card

MAGNETIC CARTRIDGE . . . in 15 models

Designation: Mag-Trap

Features: Smooth-surfaced assembly wipes clean quickly. Permanent Alnico V magnets arranged for optimum expansion of flux field. No progressive accumulation of ferrous particles. To clean,

no need to drain reservoir or stop operations. Two models use air breather for support. Others have nonmagnetic flange combinations and pipe thread adaptors.

Specifications: For mounting, cartridge has threaded plug ¼-20-NC tap, ½" deep. Cartridges are ⅝" dia.

Kerns-Morrell Co.
Detroit, Michigan

Circle **315** on Time-Saver Card

HYDRAULIC VALVES . . . control direction

Designation: A-20 & A-35—Velvet Touch Line

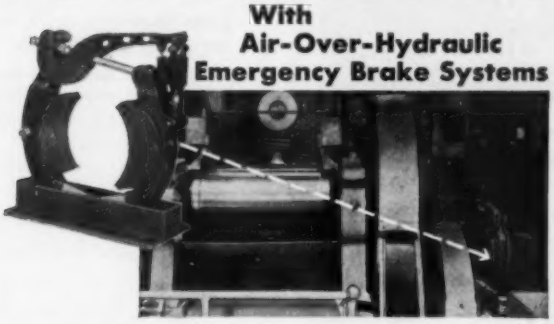
Features: Parallel circuit, directional-control valves. Backpressure

Continued on page 116

Circle 114 on Time-Saver Card

STOP "INRUNNING ROLLS" SAFELY

With
Air-Over-Hydraulic
Emergency Brake Systems



Wagner A/H Emergency Brake Systems protect the operator (as required by safety codes) against the extreme hazards involved in operating machinery with inrunning rolls. An industrial-type brake is applied by an air-operated hydraulic power cluster to stop rolls quickly, smoothly, and with minimum strain on the drive. Systems incorporate safety devices to meet other emergencies, such as loss of air pressure or failure of power supply.

Brake assemblies are ruggedly constructed, are easy to install . . . require no special motor starters or control, no direct current. Maintenance is minimized . . . there is practically no lining wear, no heavy solenoid coils to burn out.

Apply these systems to your rubber or plastic mills, refiners, washers, crackers. Available with 6, 8, 10, 14, or 18 inch diameter brakes. Your nearby Wagner Sales Engineer has the complete story. Call him, soon.

W160-3

Wagner Electric Corporation
6387 PLYMOUTH AVE., ST. LOUIS 33, MO., U.S.A.

this is SEAL-GUARD®!

the modern, truly efficient rod-wiping component

The modern and most effective means for keeping your hydraulic and pneumatic systems clean is with *Seal-Guard.* This rod-wiping component consists of (1) two knife-like bronze wiper rings which throw all foreign matter outward as rod retracts into cylinder and (2) a synthetic rubber retaining ring which absorbs shock and side load, holds wipers in full contact with rod and provides an overall outside seal.

Send today for all the facts on . . . **SEAL-GUARD®** write to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.

Industry's Partner in Production

E. F. HOUGHTON & CO.

Philadelphia, Pa. • Chicago, Ill. • Carrollton, Ga. • Detroit, Mich. • San Francisco, Cal. • Toronto, Canada

Circle 56 on Time-Saver Card

One wart hog might look great to another . . . . .

but when it comes to custom cylinders and valves—we're biased—we believe we look better than anybody. Write, or better yet, call, we'll talk!

Universal Hydraulics
DIVISION OF HOLAN CORPORATION
P.O. Box 4500 · Cleveland, Ohio
Phone Whitehall 2-4595

Circle 110 on Time-Saver Card

Circle **73** on Time-Saver Card

LINEAR SEALS

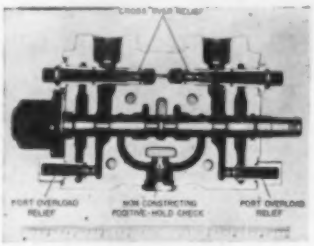
O RINGS
V RINGS
U CUPS

Close tolerance molding in compounds to meet every operating condition.

PERFECTION IN RUBBER
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA 35, PA.

NEW PRODUCTS

characteristics improved. Increased system efficiency. Precision-engineered, exponential curved edges



on spool lands give high degree of flow metering. Metering eliminates jerky movements in mobile or crane equipment. Enlarged through passages. Reduced land dimensions. No sharp angles in flow passages. Crossover relief valves, overload port relief valves, pilot-operated port checks, anti-cavitation checks, and flow-restrictor checks can be built into working section. Available 3-way 3-position, 4-way 3-position, 4-way 4-position, and 4-way 5-position (2 float positions).

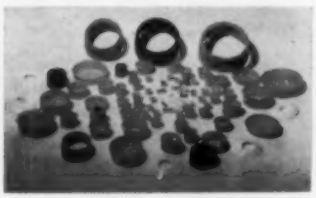
Specifications: A-20 for 20 gpm and 2000 psi. A-35 for 35 gpm.

Commercial Shearing & Stamping Co.
Youngstown, Ohio

Circle **316** on Time-Saver Card

PROTECTIVE COVERS . . . are polyethylene

Features: Caps and plugs, finishing flanges, and conduit thread protectors protect parts in assembly and shipping. Over 80 standard designs. Used on pipe, tubing, conduit, and other small and delicate fittings. Don't absorb moisture.



Specifications: Sizes from 3/32" to 4". Can be custom designed.

Niagara Plastics
Erie, Pa.

Circle **317** on Time-Saver Card

Gages Got the SHAKES?
RAY PRESSURE SNUBBERS

Stop: Shaky or False Readings
Erratic Operation of Equipment
Frequent Instrument Calibration
Excessive Wear on Instruments and Equipment

Only RAY Gives you all of these
Easily and quickly installed • Self cleaning • Functions in any position • No maintenance • vacuum to 20,000 p.s.i. • brass, stainless steel, monel, or aluminum • for air, water, steam, gases, oils, chemicals • adjustable — 13 variations • precision made to .00025 in. • stock delivery — special units designed to order.

Used by U. S. Navy, Air Force, Maritime Commission and thousands of industrial leaders.

Mail Coupon now to order snubbers, or for complete information.

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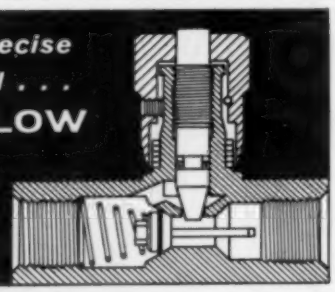
300 W. 3rd St., Charlotte 1, N. C. Order No._____

Pipe Size_____
Fluid Used_____ Operating Pressure_____
Ship Immed._____ (qty.) RAY Pressure Snubbers
Send Complete Information ☐
Company_____
Name_____ Position_____
Street Address_____
City_____ Zone_____ State_____

Circle **87** on Time-Saver Card

For more precise Flow Control . . .
COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- **Simple reading, recording, setting and adjusting**
- **Safe — adjustable under pressure**
- **Setting can be locked to hold adjustment**
- **Extremely sensitive — provides high flow and minimum pressure drop**

- **For oil, gas, vacuum, water and other fluids**
- **Pressures: Brass to 2000 psi Steel to 5000 psi**
- **Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads**

Write for detailed literature

THE MANATROL Corp.
2372 W. 7th St. • Cleveland 13, O. • CH 1-0575

Circle **77** on Time-Saver Card

CHECK VALVE NYLON INSERT
. . . has new uses

Features: Insert has rotating action. Eliminates corrosive agents. Can be

adapted for couplings and unions. No troublesome center pilot. Works in any position, regardless of angle. Foreign substances cannot build up to obstruct operation.

Check-All Valve Co.
Des Moines, Iowa

Circle **318** on Time-Saver Card

AXIAL-PISTON PUMPS
. . . deliver to 142 gpm

Specifications: 500-hp pump (shown) delivers 142 gpm at 1200 rpm, 5500 psi. 40-hp pump delivers

4 gpm at 5000 psi. When fitted with low-pressure vane, it delivers 22 gpm at 1000 psi.

Towler Brothers (Patents) Ltd.
Rodley Nr. Leeds, England

Circle **319** on Time-Saver Card

RING SEAL
. . . is all metal

Designation: Hi-Temp Series 90 & 91

Features: Non-split ring seal is for hydraulic and pneumatic linear motion. Use in hydraulic actuators, as static seals, and in swivel joints. Metal lip fastened in stainless steel ring. Ring supports lip axially, prevents blowout under extreme pressures.

Specifications: For temperatures from −425 to 1500 F. Withstood leakage tests at pressures beyond 20,000 psi. 90 Series is standard. 91 Series (double units) for pressure reversals over 10 psi. Each series has 37 sizes. Bore diameters from ½" to 7".

Gits Bros. Mfg. Co.
Chicago, Illinois

Circle **320** on Time-Saver Card

CUP PACKINGS
. . . for low friction

Designation: Rex-Syn

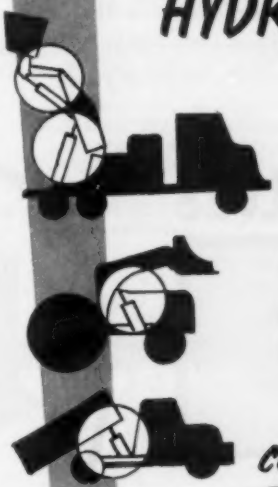
Features: Made of resin-elastomer blend. Efficient in air, oil, water, and water base, fire-resistant hydraulic fluids. High abrasion resistance.

Specifications: Tensile strength is over 3000 psi. After 7 days of air aging at 158 F, tensile variation

Continued on page 118

ON THE JOB...

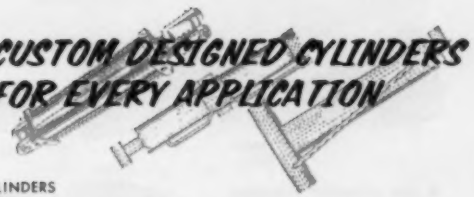
with CROSS HYDRAULIC CYLINDERS



Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION



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Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

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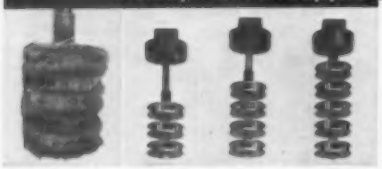
WRITE • WIRE • PHONE... TODAY!!

Circle **35** on Time-Saver Card

Circle **68** on Time-Saver Card

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

NEW PRODUCTS

was +6.6%, hardness increased 9 points. Extremely fine cylinder finish not necessary. Micro finish

under 32 rms has been found adequate. In standard sizes to 6" OD.

E. F. Houghton & Co.
Philadelphia, Pa.

Circle **321** on Time-Saver Card

FILTER ASSEMBLIES . . . for 150 psi

Designation: Series 3100

Features: General-purpose series has pore ratings from 2 to 100 microns. Element materials; woven wire cloth; sintered bronze; pleated, resin-impregnated cellulose sheet; stacked, resin-impregnated cellulose washers; and helically-wound, resin-impregnated cellulose ribbons. Aluminum housings are blue anodized.

Specifications: Elements for −350 to 350 F. Rated operating pressure is 150 psi. Burst pressure is 600 psi.

Bendix Filter Div.
Bendix Corp.
Madison Heights, Mich.

Circle **322** on Time-Saver Card

Continued on page 120

new ROTORAM® VALVES

WITH EXCLUSIVE ROTATING STEM
for MILLIONS of TROUBLE-FREE ACTUATIONS

Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish

Cam Valve

Finger Valve

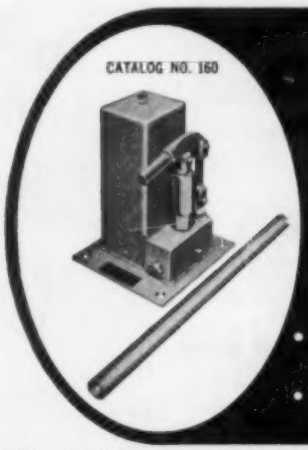
Pedal Valve

Hand Ball Valve

Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

Circle **6** on Time-Saver Card



Hand Hydraulic Pumps

- Single and Double Designs to 20,000 psi
- With or Without Reservoir

160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

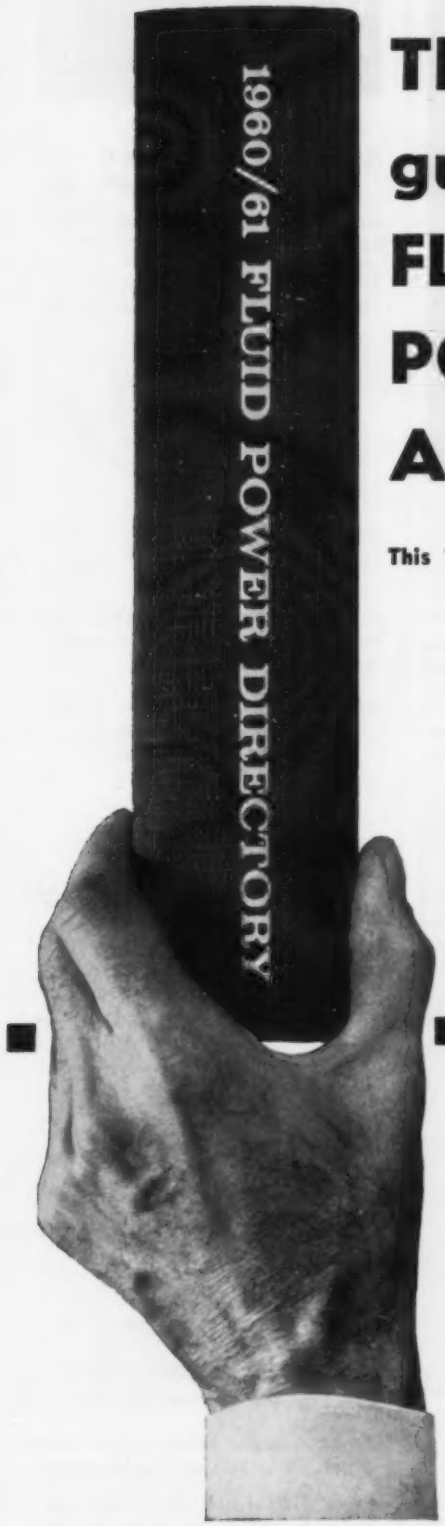
We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE
hydraulic hand pumps for 1001 uses
1635 East 22nd St., Los Angeles 11, Calif.

Circle **93** on Time-Saver Card



The complete guide to FLUID POWER APPLICATIONS

This 1028 page volume includes:

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- ***TRADE NAMES*—cross referenced to makers.**
- ***DIRECTORY*—who makes what for hydraulic and pneumatic systems: over 150 product groups, more than 800 manufacturers listed for easy reference.**
- ***DESIGN MANUAL*—circuits, nomographs, designs and applications: a complete handbook for industrial, mobile and aviation systems.**
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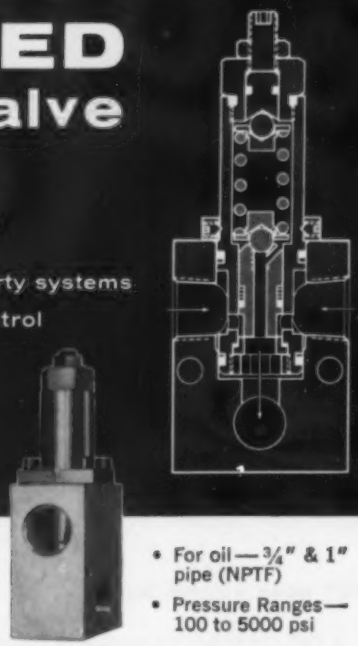
Circle **43** on Time-Saver Card

* **RUGGED**
Relief Valve

Differential Piston Design

- Dependable even in dirty systems
- Accurate pressure control
- Long Life - hardened steel working parts
- Fast Acting
- Low cost



* Developed especially for critical applications where failure to hold pressure would be hazardous.

- For oil—¾" & 1" pipe (NPTF)
- Pressure Ranges—100 to 5000 psi

WRITE FOR DETAILS

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

P.O. BOX 186 • MENTOR, OHIO

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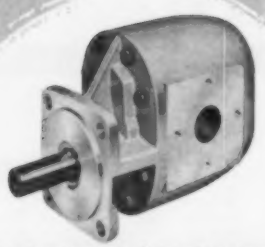
NEW **Maximum Performance** GEAR PUMP

Speeds to 2800 RPM

Temperatures to 250° F with min. 55 SSU

Pressures to 2250 PSI continuous

Flow rates to 60 GPM



BERRY/DOWTY GPA3 Series

- Designed for operation at mobile equipment engine speeds
- Can be direct-connected, gear driven or belt driven
- Conforms to SAE standards

MAIL FOR COMPLETE DATA

Berry Hydraulics
Corinth 1, Miss.

Name_____

Company_____

Berry HYDRAULICS
A DIVISION OF THE OLIVER TYRONE CORPORATION

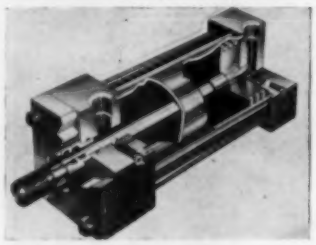
Circle **25** on Time-Saver Card

NEW PRODUCTS

HYDRAULIC CYLINDERS . . . for 1000 psi

Designation: Series L—The Thousand Pound Line

Features: Square head and tie rod. Case-hardened and hard-chromium-plated piston rods. Drip-free rods. Leak-proof ports. Fourteen mountings.



Specifications: Bores are 1" to 8".

Power Cylinder Div., Hannifin Co.
Div. Parker-Hannifin Corp.
Des Plaines, Illinois

Circle **323** on Time-Saver Card

SOLENOID VALVES . . . are packless

Designation: 1500 Series

Features: Direct-lift action and full-ported construction insure reliability regardless of pressure drop or flow conditions. Bubbletight. Leakproof. In bronze or stainless steel.

Specifications: For 0-1500 psi, −350 to 450 F. In ¼" to 1" pipe sizes.

Atkomatic Valve Co.
Indianapolis, Indiana

Circle **324** on Time-Saver Card

USEFUL LITERATURE

Continued from page 54

Metallic Static Seals

For zero leakage, compressive force is balanced on seal and seal coating, material, and thickness, so that coating is forced into tool marks of seal cavity. Lapped sealing surfaces. High flange loads are not required. Flanges may be made thinner, with wider bolt spacing. Normal flange finishes are suitable for no-leak applications. Although 32-rms surface finish is recommended, 100-rms finishes may be sealed. Can be supplied to seal irregular shapes and sizes and all standard AN cavities. Charts of Catalog 1000 have part numbers, dimensions, dash numbers. Graph of load vs. seal compression. Materials include K Monel, 17-7 P.H., and Inconel X. For temperatures to 1750 F. Special coating and materials for 2000 F. OD from .125" to 6.000". *Servotronics, Inc., Buffalo, N. Y.*

Circle **415** on Time-Saver Card

Servo Analyzers

Automatically computes and plots gain-phase characteristics of any two signals within system, or input and output of separate component. Operates with ac carrier or dc servo signals, or combination. Easily operated by nontechnical personnel. No calibration requirements. Permits wide variation in component part tolerances. Simultaneous readout of frequency, amplitude ratio, and phase angle. Measures system closed-loop response, system open-loop response, system component response, and individual component response. When used with 2-axis recorder, analyzer produces Bode plots or Nichols charts. *Metrolog Corp., Pasadena, Calif.*

Circle **416** on Time-Saver Card

Valves & Cylinders

Air switch has ball with one recessed surface. Operating lever rotates ball on pin axis. O-rings seal upper and lower portions of ball. Recess connects cylinder to pressure or exhaust. Rotate ball by plunger travel or shaft rotation. Actuate by solenoid, pilot, push-button, toggle lever, palm button, ball cam, pedal, or indicator knob. Single-cartridge (2 and 3-way) and double-cartridge (4-way) models. NO or NC without change of ports. Air cylinders rated at 150 psi. Single and double rod ends. ¾" and 1¼" bores. Double acting standard. Tandem cylinders. Bulletins A, B, C, and 10 to 110 also show exhaust dump valve and control valve, pressure selector valve, and check valve. Plastic tubing, air cables, and tube fittings. Sample circuit. *Compressed Air Service Co., Dayton, Ohio.*

Circle **417** on Time-Saver Card

Tandem Cylinders

Two cylinders in line have common head at center. Two pistons on rod. For hydraulic control of air cylinder. Use hydraulic fluid in front cylinder or in center section, without make-up chamber. For speed control, pipe flow-control valves in series with two ports used for hydraulic section. Stainless steel rods and steel or brass tubes are treated for corrosion. Bores are 1½", 2", 2½", 3", and 4". Lengths to 80". Mounts are swivel bracket, rod clevis, flange, trunnion, and foot. Fixed cushions on 1½" bores. Adjustable cushions on others. For 150-psi air, water, and 500-psi hydraulic fluid. Type BT. *Allenair Corp., Mineola, N. Y.*

Circle **418** on Time-Saver Card

Rotary Screw Compressors

Two helical rotors mesh inside housing. Four compression cycles from each revolution. Constant flow of pulsation-free air. Rotors never touch each other or housing. No lubrication inside compression chamber. Dirt particles can't cause abrasion. Capacities from 6900 to 19,400 cfm at pressures to 115 psi. Low and high-pressure stages can be used as single-stage compressors. Change speed to change output. Direct coupling to two-pole electric motors. 60% of power input at compressor shaft may be recovered in the form of hot water. Types U1210, U1311, U1412. Leaflet A 1141. *Atlas Copco AB, Stockholm, Sweden.*

Circle **419** on Time-Saver Card

LET'S TALK MANIFOLD FACTS!

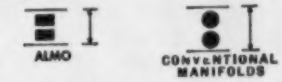
The advantages of (Almo) manifolds as opposed to other manifolds are many. Their unique design offers complete flexibility in the mounting of take-offs and valves. Thus an Almo manifold is more adaptable to your requirements. Here are 3 features that definitely effect performance, weight and size.

ALMO*
HYDRAULIC MANIFOLDS

1. Flow lines are short as possible with no corners or sharp recesses to collect dirt and obstruct flow.

2. Method of construction permits better utilization of area, smaller overall dimensions and fewer complications while maintaining correct channel dimensions and constant operating pressures. PSI capacity is a built-in quality.

3. Rectangular cross section of flow lines makes possible thinner overall construction and less weight than in comparable manifolds.



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Let us work with you in improving your product. Write for brochure.

ENGINEERING RECOMMENDATIONS
"THE UNIQUE FLUID CIRCUIT"

ALMO
MANIFOLD & TOOL CO.
11472 KALTZ / CENTERLINE, MICH.

Circle **10** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Racine forms mobile hydraulic division

Prompted by increased mobile hydraulic sales and the use of hydraulic components and circuitry

Robinson

Hellenberg

in mobile applications, Racine Hydraulics & Machinery Inc., Racine, Wis., has established a mobile hydraulics division. Harold L. Robinson is sales manager of the new division, and Clare Hellenberg is chief engineer. Eugene Crossland, application engineer, and Edward Brannon, product designer, also joined the new division.

Plastic & Rubber promotes Tinkham

L. N. Tinkham, in the new position of assistant sales manager of Plastic & Rubber Products Co., Los Angeles, Calif., will assist E. F. Noyes, vice president of sales in the overall sales direction and supervision of the firm. Tinkham has been with the company for 14 years.

New name for Paul-Munroe

The Paul-Munroe Company, Bell Gardens, California, have changed their name to Paul-Munroe Hydraulics. The name change was made to more clearly define the scope of the company's activities. The company also announced the addition of two engineers, Bob N. Cameron and Charles F. Robertson.

Grimstad adds sales engineer

J. M. Grimstad Company have added John S. Reed to their Rockford, Illinois, office staff. Reed has had an extensive background in hydraulics and pneumatics, his last position as assistant chief engineer, Packaging Machinery Div. of W. F. & John Barnes Company.

Groh joins OPW-Jordan

G. A. Groh was appointed sales engineer for OPW-Jordan Corp., Cincinnati, Ohio. In addition to his sales engineering responsibilities, Groh will handle much of the company's technical correspondence and supervise sales efforts in several territories.

Berry Hydraulics names sales manager

H. S. Cain was appointed sales manager of Berry Hydraulics, a Division of Oliver Tyrone Corp. He will be located at the general sales office in Corinth, Miss. Cain previously serviced accounts from Houston and Pittsburgh.

John P. Weatherhead promoted

John P. Weatherhead was named plant manager of the Special Products Division, The Weatherhead Company, and will direct all manufacturing activities in the Cleveland plant. He has been with The Weatherhead Company for 22 years and has been manager of the Syracuse, Indiana, plant since 1953.

Le Roi names four in sales

Thomas E. Stone is mountain region sales manager for Le Roi Div., Westinghouse Air Brake Co. Regional headquarters are in Denver. Territory includes Colorado, Utah, eastern Idaho, Wyoming, Montana, and western North Dakota, South Dakota, and Nebraska. Replacing Stone as district representative in Salt Lake City is H. A. Orlik. He will cover

Stone

McPhail

Utah, eastern Idaho, and western Colorado. Stone succeeds W. E. Mattson, who was transferred to Milwaukee to head central region sales. Winston MacPhail will work as a field representative, out of the regional office at Cleveland, Ohio.

Continued on page 124

Circle **99** on Time-Saver Card

LOCK OUT AIR FOR MACHINE REPAIR

Ross

Locks Out and eXhausts VALVE

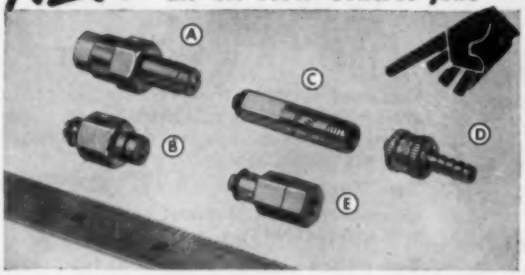
Lock out air that operates a machine, as a safeguard when making machine repairs. The Ross L-O-X Valve installs in the supply line leading to the machine, upstream of any operating valve. Designed so that when closed, supply-air to the machine is shut off and air downstream is exhausted. Can be padlocked in this position.

More L-O-X valves can be incorporated in the circuit to shut off and exhaust various segments of the circuit. Detented open; very low pressure drop; Lightweight aluminum construction. Call your Ross representative or write for literature.

ROSS OPERATING VALVE CO.

105 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

NEW MIDGETS for MAN-SIZED air-oil Flow Control jobs!



Ⓐ **MINIATURE FLOW CONTROL** — Operates on 1 lb. differential. Limited check one direction — full flow other. Recommended working range 0-250 psi. Air flow rate 3.6 CFM at 50 psi.

Ⓑ **MINIATURE NEEDLE VALVE** Precise control of air-oil in either direction. Range 0-2000 psi.

Ⓒ Ⓓ **MINIATURE QUICK CONNECT** — Air flow rate 2.7 CFM at 50 psi. Range 0-150 psi.

Ⓔ **MINIATURE CHECK VALVE** Poppet type, spring loaded. Full flow one direction only. Use in any position. Holds 0-2000 psi. Air flow rate 3.5 CFM at 50 psi.

Clippard Minimatics TRADE MARK

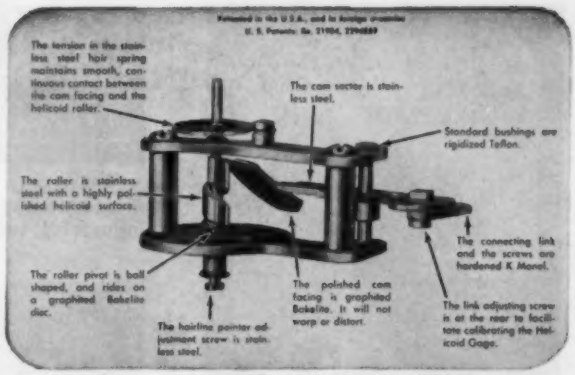
Write, NOW for NEW BULLETIN No. B-59

Clippard INSTRUMENT LABORATORY, INC.

7386 Colerain Rd., Cincinnati 39, O. • Phone: JAckson 1-4261

Manufacturers of Miniature Pneumatic Devices, R.F. Coils, Electronic Equipment

Circle **32** on Time-Saver Card


The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides *Sustained Accuracy* ...on the toughest jobs!

• Helicoid Gages have no gears, no teeth—wear is reduced to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Even when subjected to violent pressure pulsations or mechanical vibrations, Helicoid Gages *stay* accurate. Only Helicoid Gages provide *all* these advantages:

Sustained accuracy—Helicoid movements have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy. Conventional *geared* gages on the same test became useless after only 500,000 cycles.

Durability—Bourdon tubes won't stretch, leak or crack. Dial faces won't corrode or chip.

Wide selection—Gages are available for practically any application from tap water to acid. Gages include flanged and flangeless, round and square, in standard and flush-mounting models. Accessory equipment includes gage cocks, needle valves, siphons and snubbers.

NEW! Solid-Front Safe-T-Case Gage

This new Helicoid design diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming the back cover plate, which can then be replaced inexpensively.

Write for Catalog DH-65 for details on the complete line of Helicoid Gages

Distributed in Canada by Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

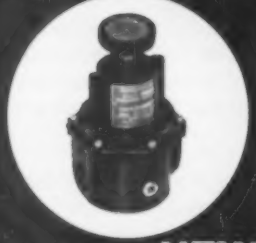
HELICOID GAGES

ACCO

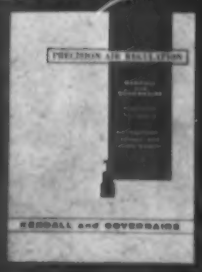
Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

Circle **55** on Time-Saver Card

DO YOU USE
PRESSURE REGULATORS?



SEND FOR NEW FREE CATALOG ON
KENDALL®
and
GOVERNAIRE®
Catalog gives performance and other data on 18 models of precision pneumatic pressure regulators (pipe sizes ¼" to 1" NPT)



STRATOS®
A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION
INDUSTRIAL PRODUCTS BRANCH
West Babylon, L. I., N. Y.

Circle **105** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Braas named industrial sales manager

Braas

Owatonna Tool Company, Owatonna, Minn., appointed James E. Braas to this position. He will direct the sales of the new Vanguard two-speed hydraulic pump recently introduced by the company and will be in charge of specialized equipment lines. He was previously manager of distributor sales with Warner Electric Brake & Clutch Co.

Briggs names Yedlinsky

Walter E. Yedlinsky was named by the Briggs Filtration Company Washington, D. C., as representative for industrial sales in the western Pennsylvania area.

Vickers promotes Haydon and Asch

Merrill A. Haydon, general manager of the Machinery Hydraulics Div., Vickers, Inc., was elected vice president. He became general manager when the division was formed in 1957. E. L. Asch is Vickers' director of sales training. He was in charge of the Houston sales office.

Greer promotes two

Donald K. Marsh was named general sales manager of Greer Hydraulics, Inc., with offices in Los Angeles, the company's new headquarters. Marsh has been with Greer since 1959. Leonard H. Seeman was appointed sales manager of Greer's Products Division, with his base of operations at the new eastern offices in Westbury, L.I., N.Y.

New...from MARSH!

MARSH
Master-mite
SOLENOID VALVES

Conduit-type Master-mite. Grommet-type also available.

Small Solenoid Valves that fill a BIG Order

Designed to meet the need for positive-acting tight-seating valves for use on wide variety of media, including oxygen, hydrogen, acetylene, etc.

Two Types:
Conduit type and grommet type. Port sizes 1/8" and 1/4" NPT.

Ten orifice sizes: 3/64" through 1/4".

Wide range of voltages:
Standard with 115 V. A. C. but also available in 12, 24, 208, 230, 460 V. A. C.

Pressure to 540 psi.
Small, but with more strength in the Marsh manner. Coils never overheat. Entire assembly leak tight. Remarkably quiet operation. Cleanable without breaking connections. Used in any position. Bodies either brass bar stock or 18-8 stainless steel. All moving parts stainless. Underwriters' approved for use on oxygen and hydrogen and as safety valves.

Write for new bulletin

MARSH INSTRUMENT COMPANY
Dept. 19, Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada, Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

Circle **78** on Time-Saver Card

Spence elected vice president

Willard H. Spence was elected vice president and general manager—Industrial Products Division, Brown & Sharpe Manufacturing Co., Providence, R. I. He will also continue as managing director of the company's British manufacturing subsidiary in Plymouth, England.

Racine Hydraulics appoints director of research

Due to a current expansion of the research and development program at Racine Hydraulics & Machinery, Inc., Racine, Wis., Russ A. Henke was appointed director of research. Henke was previously head of Russ Henke Associates, consulting firm, which his former associates are continuing under the name of Engineering Associates. Robert E. Raymond, formerly in charge of research, plans to operate his own consulting business. Raymond will continue as an advisor to Racine Hydraulics. The company's new research and development building is nearly completed and all research for six plants in Wisconsin and Ohio will eventually be concentrated here.

Henke

Jarvis

Hydreco promotes Jarvis

W. Gordon Jarvis was appointed manager of manufacturing of the Hydreco Division of New York Air Brake Co., Kalamazoo, Mich. Jarvis, associated with Hydreco for five years, has been serving in executive capacities in sales, production and personnel.

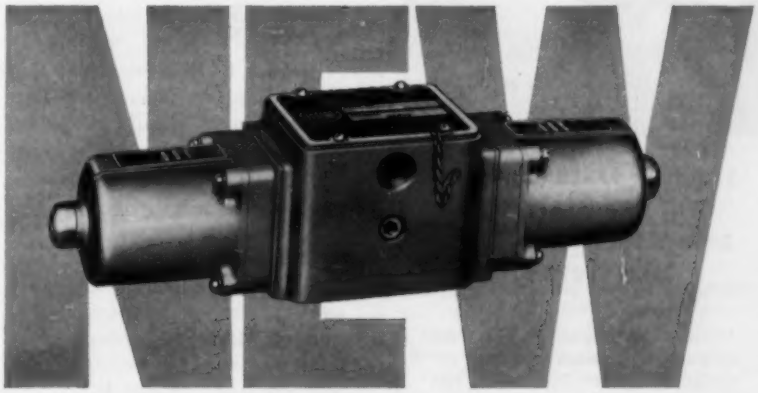
UCC opens service lab

A new technical service laboratory, centralizing Union Carbide Chemical Co.'s customer service facilities, was opened near Tarrytown, N. Y. The building, which houses 46 individual laboratory units and a well equipped mechanical test building, brings together various groups which had been attached to Carbide Chemicals plants throughout the country. Among its purposes is follow-up of customer requirements for specific chemicals, to determine the need or desirability of improved specification standards, and to assist customers in the proper use of the company's products.

New company formed

Continental Controls Company, Nashua, New Hampshire, is a new organization manufacturing a line of electrohydraulic control components and systems. The company also provides a consulting service for their customers to assist in special control problems. Werner G. Holzbock is president. The company will operate through local distributors.

Continued on page 123



H-P-M ¼" four-way pilot valves, single or double solenoid

The new H-P-M ¼" pilot valve is interchangeable with industry standards, handles 9 gpm at 3000 psi, single or double solenoid types available. These are quality valves for long, heavy-duty service at a price comparable with ordinary solenoids. Subplates available for standard mountings.

H-P-M pilot valves feature totally sealed, oil-immersed solenoids for long life and maintenance free operation — virtually millions of extra cycles. Immersed in oil, the solenoid operates cooler, shock and pounding is lessened, normal problems experienced with air gap type solenoids are eliminated. Oil-immersed solenoids have bayonet type connections; service is simplified with no wire connections to break.

AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY.
Send for new specification sheets, today.

H54

HPM

THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **59** on Time-Saver Card

DESIGNED EXCLUSIVELY FOR THE MAN WHO WANTS COMPACTNESS, RELIABILITY AND ECONOMY!

Introduced by Modernair in 1948, these ultra-compact cylinders have been performance-proved on thousands of jobs all over the free world.

Today's new Series R ECONOMAIR cylinder is even better. In addition to such original advantages as compactness and interchangeable mountings, the new Series R offers:

- **Chrome plated stress-proof steel piston rods with wrench flats.**
- **Built-in rod wipers.**
- **Wider-sectioned aluminum piston for improved bearing stability.**
- **Exclusive Adjusto-Stroke Design. (Pat. Pend.)**
- **1⅛ bore has stainless steel rod.**

Series R ECONOMAIR cylinders are available now in 1⅛, 1½, 2, 3 and 4-inch bore sizes, with or without cushions. They offer today's best buy in quality cylinders at truly competitive prices—why pay more and get less?

See your phone book yellow pages for your nearest dealer or write us **now** for literature and prices. Please address Dept. 05.

Modernair CORPORATION

400 Preda Street • San Leandro, California
5007 Brookpark Road • Cleveland 34, Ohio

Circle **82** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Arizona sales rep for Young Radiator

John J. Cullinane has been appointed sales representative for the Young Radiator Company, Racine, Wis., with offices at Glendale, Arizona.

Superior Tube appoints Hoff

Richard L. Hoff returns to Superior Tube Co., Norristown, Pa., as development metallurgist, after working one year as a senior engineer at Aerojet General Corp.

Hall joins Marsh

John W. Hall was appointed sales engineer of the Solenoid Section of Marsh Instrument Company Division of Colorado Oil and Gas Corp., Skokie, Ill.

Cameron now assistant sales manager

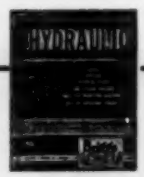
Robert D. Cameron was appointed assistant sales manager of the New York Air Brake Company's newly formed industrial sales organization, Watertown, N. Y. He joined the company in 1956 and has been located at the Los Angeles aviation sales office.

Dagerman has new position

Dagerman

E. M. Dagerman has been appointed to the new position of west coast district sales manager of the Marine and Ordnance Department of Vickers, Inc. All sales personnel in the Pacific states will report to Dagerman. Dagerman, with Vickers for 14 years, has served in many capacities in the company's sales, engineering and manufac-

GRATIS . . . a 12 page HYDRAULIC CIRCUIT and FLUID MANUAL for almost every type and size hydraulic installation.



HERE IS A BIG 8½" x 11", file size 12 page, fully illustrated booklet. It's brimful of technical data and drawings that every designer and operating engineer will want to read and keep for ready reference. Write for your copy. No obligation.

Briggs

HYDRAULIC FLUID AND OIL FILTERS

FILTER/SEPARATORS • AIR AND GAS LINE FILTERS • FILTER CARTRIDGES

YES! THE BRIGGS FILTRATION CO.
DEPT. 349 WASHINGTON 16, D. C.
Send me manual. No obligation.

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Company .....
Address .....

Circle **26** on Time-Saver Card

turing operations. He will maintain offices at the El Segundo, Calif., plant.

Parker-Hannifin moves New York sales office

The New York sales office has been moved to new, larger quarters at 19 Railroad Ave., Emerson, N. J.—William A. Case has joined the company's Detroit sales office.

New distributor organization formed

Heyck Equipment Company, Inc., 3260 Sul Ross Street, Houston, Texas, has been formed. The new firm was formed by T. R. Heyck and W. N. Sinclair, who were previously associated with Johnson-Heyck, Inc. T. R. Heyck is president and Sinclair is vice president. The company will act as exclusive distributors and represent a number of accounts previously represented by Johnson-Heyck, Inc.

Le Roi appoints central region manager

Mattson

W. E. Mattson was named central region sales manager of the Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis. Mattson, formerly manager of the division's mountain region, joined Le Roi in 1953. The division also announced the central region's new headquarters at the Mayfair Professional Building, 2500 N. 108 St. Milwaukee.

Promotions at Chiksan

Chiksan Company, Brea, Calif., appointed N. A. Lee Guill to eastern regional sales manager with headquarters in Newark, N. J. W. L. Clark replaces Guill as senior sales representative in the Midwest, with headquarters in Chicago.

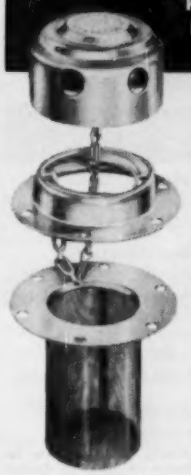
Continued on page 128

Circle **72** on Time-Saver Card

ANOTHER FINE QUALITY PRODUCT By LENZ

FILLER CAPS & SCREEN ASSEMBLIES

For HYDRAULIC FLUID and OIL RESERVOIRS



BREATHER CAPS
Vented type made of cadmium-plated steel ... Twist lock fastens securely into flange. With or without chain.

CLOSE NECK FLANGE
Cadmium plated steel with six 7/32-inch flange holes drilled on 2⅛-inch circle.

30-MESH BRASS WIRE SCREEN
Unusually well constructed brass screen, 3-inches deep and 1 13/16-inches diameter.

Write Today For FREE Tube-Hose Fittings and Accessories Catalogs

The LENZ Company
3303 Klepinger Drive
Dayton 1, Ohio
Phone: CR 7-9364
For Nearest Distributor See Thomas Register A-Z Section

See Fluid Power Directory for Complete Catalog

NEW! KEPNER Kepsel

Flexible Sealing Disc

Instant Action and Design and Installation 75% and more!

- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

*Patent Applied For

Write for complete technical data

KEPNER PRODUCTS COMPANY
7321 West 59th Street Summit, Illinois

Circle **70** on Time-Saver Card

Need an original equipment VACUUM PUMP?

See how GAST cuts your costs

Above (1) is basic Model 1550 Vacuum Pump—(one of 13 sizes). For active customers, Gast builds this model in dozens of variations. Specific needs are met for vacuum, pressure, lubrication, drive and type of service.

For example, (2) is equipped for general purpose vacuum. (3) provides both vacuum and pressure for paper feeding. (4) oil-less model has carbon vanes; never needs oil. (5) has new constant level oiler for rigorous industrial duty.

You save because Gast *ingenuity* and *tooling and manufacturing efficiency* permit high quality at production prices.

WRITE FOR FULL DETAILS—REQUEST CATALOG

Gast Manufacturing Corp.
P.O. Box 117-D
Benton Harbor, Mich.

GAST ROTARY

- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 29 IN.

"Air may be your answer!"

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Circle **60** on Time-Saver Card

So Much Control . . .
So Little Space

HUSCO HYDRAULIC VALVES

HUSCO 4-Plunger, 45 G.P.M. Series 3200-SP Valve

- In ONE to SIX Plunger Designs
- For up to FOUR Control Positions
- Capacities from 3 to 185 G.P.M.

Other HUSCO features include:

- Power-Saving Pilot-Operated Relief Valve.
- Short Plunger Movement for more accurate control — at minimum effort.
- Check Valve Controlled circuits — Conventional or Parallel.
- Compact, precision-built for minimum space.
- Over 120 Standard Models — for unlimited modification to your needs.

Check HUSCO *First* for Hydraulic Control. Write for your copy of HUSCO'S "House of Ideas in Control Engineering" — or design assistance on your needs.

HYDRAULIC UNIT SPECIALTIES CO.
PUMPS • VALVES • CYLINDERS
P. O. Box 257-A, Waukesha, Wisconsin
West Coast Representatives
EASTMAN PACIFIC CO., Los Angeles, Calif.
ROY BOBBS AIR-DRAULIC CO., Portland, Ore.

POST SCRIPTS OF INDUSTRY

New distributors

Holden Engineering Co., Cleveland, *Ancar Engineering, Inc.*, Chicago, and *Industrial Technical Sales & Service, Inc.*, Mansfield, Ohio, will handle the Crown line of compressed air filters, regulators, and lubricators made by Hannifin Co., div. Parker-Hannifin Corp., Des Plaines, Illinois. *Specialties, Inc.*, Alexandria, Va., will distribute the Crown line, and tube and hose fittings made by Parker Fittings & Hose Div., Cleveland. *Coleman Co., Inc.*, Greenville, S. C., will handle the division's industrial hose and reusable hose fittings.

Walnor Corp. will distribute for Republic Mfg. Co., Cleveland. Walnor offices in Chicago, Moline, and Rockford cover Illinois. The Des Moines and Cedar Rapids branches will give Republic coverage in Iowa.

Mechanical Air Controls, Inc., Detroit, has named four distributors. *Automation Equipment & Supply Co.*, Pittsburgh, is assigned to western Pennsylvania, West Virginia, and eastern Ohio. *Stewart-Hunt, Inc.*, Lexington, Mass., will take New England. *Goll-Hanford Corp.*, has the Buffalo area. *Leo J. Schindler Co.*, Dallas, will represent MAC in Texas.

Hydro-Line Mfg. Co., Rockford, Illinois, has appointed *Charles Weber Co.*, Louisville, Ky., *Affiliated Engineering Corp. Ltd.*, Montreal and Toronto, and *Andy & Associates*, Dallas.

Conoflow Corporation has appointed *R. Mack Goble Company*, Houston, Texas, as sales agents for the Houston-Gulf Coast area, and *E. N. Murray Company*, Denver, Colorado, as representatives in Colorado and Wyoming.

Scott Industrial Equipment Co., Indianapolis, will distribute hydraulic valves and cylinders for Rivett, Inc., Boston. Scott's territory is Indiana and Kentucky.

STAFFA

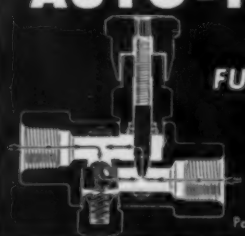
HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Mark IV—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.
Ask for details of hydraulic cylinders, valves, pumps and motors.

CHAMBERLAIN INDUSTRIES LTD
Staffa Works, Argall Ave., Leyton, London, E.10, England.
Leytonstone 3678
(Member of the Chamberlain Group of Companies)

Circle **31** on Time-Saver Card

AUTO-PONENT®
HYDRAULIC FULL FLOW VALVES
Flow Control, Needle, Check, for HYDRAULIC Power



Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

Pat. #2,841,174

A complete line: ⅛", ¼", ⅜", ½", and ¾" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

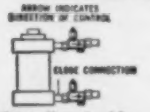
Model F Standard Flow Control Valve or Model N Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

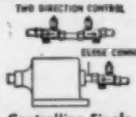
Model PF Knob and Dial Flow Control Valve, or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Acting Cylinder



Controlling Single Acting Cylinder

AUTOMATION AUTO PONENTS INC COMPONENTS
2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

Circle **15** on Time-Saver Card

THE MARKET PLACE

When replying to a box number in the Market Place, address your letter to Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

PROJECT ENGINEER
Hydraulics & Pneumatics

Substantial, progressing Midwestern manufacturer seeks graduate engineer experienced in design and development. Excellent opportunity. Write resume to Box 8160 HYDRAULICS & PNEUMATICS.

DESIGNERS, DRAFTSMEN WANTED

Hydraulic and pneumatic cylinder designers by fast growing northern California cylinder manufacturer. Resumes will be reviewed confidentially. Send resume to Box 8260 HYDRAULICS & PNEUMATICS.

ENGINEER AVAILABLE

M. E. with 11 years industrial experience in design, application and test of industrial hydraulics and automotive electrical products. Desires responsible position with manufacturer of related products. Write to Box 8360 HYDRAULICS & PNEUMATICS.

DISTRIBUTORS AND REPRESENTATIVES WANTED

For proven line of industrial variable high pressure axial piston pumps and motors. All U.S. territories open. Write Box 8560 HYDRAULICS & PNEUMATICS.

AIRCRAFT HYDRAULIC ENGINEER WANTED

Southern New England manufacturer of fluid system components seeks man capable of assuming responsibility for development of valve design from concept through qualification testing. Prefer man with aircraft and/or missile hydraulic systems experience and current state of the art knowledge. This is a permanent top level position with a growing company. Full benefits. Salary open. Replies in strictest confidence. Box 8460, HYDRAULICS & PNEUMATICS.

Classified Advertising Rates: Cost of Position Wanted ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

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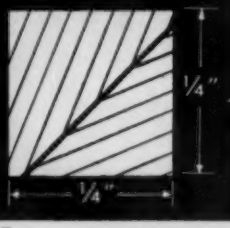
PISTON LEAKAGE PROBLEMS ? ? ?
CHANGE TO "STEP SEAL RINGS"

CROSS SECTION OF "STEP SEAL" JOINT



See the newest revolution in sealing rings by AUTO-DIESEL PISTON RING CO. The "STEP SEAL RING" has a sealing action over the entire area. This results in a ring that allows only ⅛ the leakage under 15 times the pressure of a straight cut ring—see comparison table below.

COMPARISON TABLE

STRAIGHT CUT COMPRESSION RING	"STEP SEAL RING"
With .005" end clearance has leakage rate of 150cc/min. at 400 lbs. pressure.	With .010"-.020" and .030" has a leakage rate of only 25cc/min. at 6000 lbs. pressure.

To reduce leakage to a minimum specify "STEP SEAL RING"

For complete details write for Bulletin H-57

THE AUTO-DIESEL PISTON RING CO.
3141 Superior Avenue • Cleveland 14, Ohio

palley/s SAVE UP TO 85%

SPECIAL VALUE
LARGE VOLUME STRATOPOWER PUMP

A high volume, positive displacement type hydraulic pump. Has an output to 10 gallons per minute at 1500 RPM with 3000 PSI. Maximum RPM is 4000. Has 16 tooth spline shaft. Part No. AND-20002. 99.50

NEW PALLEY Hydraulic Cylinders

These special Palley Hydraulic cylinders are designed to meet the most rigid requirements of industry. All are of heavy duty steel. Shown here are two of our line. Available in heavy duty Press type cylinders of 3", 5", 6" and 8" bores, with thrusts up to 75 TONS. Also in internal cap types (as at right, above)—with bores up to 4" and up to 18,850 lbs. of thrust at 1500 PSI. Write for complete list of Special Palco Hydraulic Cylinders.

SURPLUS 1500 PSI HYDRAULIC CYLINDER
Has bore of 3" – shaft 1-3/16" – stroke 24" – O/A length 31". Reconditioned. 34.50
palley/s Cat. No. H-36RSU

3263 E. VERNON AVE., DEPT. AH-80
LOS ANGELES 58, CALIF.

TO ORDER: Send Check or M.O. – 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles. All items shipped freight or postage collect.

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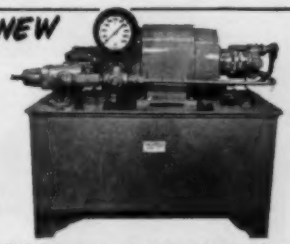

HYDRAULIC "AUTOMATION" "HI-LO" PRESSURE PUMPING UNITS
DELIVERS 21 GPM AT 1500 PSI

For use in applications where a fast approach to work load is desired. Will deliver combined volume of both pumps (21 GPM), at pressures up to 450 PSI, then delivers output of high pressure pump (4 GPM) at up to 2000 PSI. Both pumps are face mounted on a 5HP, double end, 220/440, 3-phase, 60 cycle AC motor. Mounted on a 33 gal. reservoir (available without reservoir) Size: 35" long x 18½" wide x 18½" high. Other Hi-Lo units available, write for details. Cat. No. DPR-21-1500.. Only 625.00

2250 PSI CORNELIUS COMPRESSOR AND 115 V. MOTOR 99.50
SAVE!
OUTPUT 0.6 CFM

Consists of a Surplus Cornelius Compressor – combined with a New 1/2 HP, 115/230 V., 60 cycle AC motor; a mounting frame and built-in carrying handle. Pressure tested up to 3000 PSI. Ideal to fill air tanks, laboratory use, etc.

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Circle **50** on Time-Saver Card

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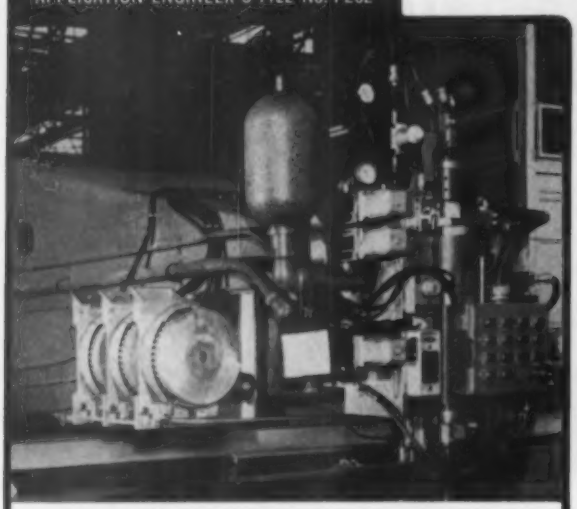

ACCUMULATORS IN MACHINE TOOLS

This giant ACF Industries Inc. "ERCO" model R300S automatic riveter utilizes two Greer bladder type 2½ gallon accumulators to supply peak flow requirements which make it possible to drill, countersink, counterbore, double head and broach rivets at the rate of 20 per minute. As in many other applications, Greer accumulators provide dependable service under precise and rugged conditions. For technical assistance on your next fluid power problem, see your local Greer distributor or write:

GREER HYDRAULICS INC.
5930 West Jefferson Boulevard, Los Angeles 16, California
496 Grand Boulevard, Westbury, Long Island, New York

Accurate Control of Fluid Motion

HYDRAULIC FEED AND PRESSURE LUBRICATION

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MACHINE TOOLS
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HOKE

Flow Sheet

HOKE REPORTS ON FLUID CONTROL (2)

WE PACKED PERFORMANCE IN A PACKLESS VALVE

The development of packless valves has so greatly reduced the problems of handling high pressures, temperatures and vacuums, and dangerous fluids that engineers designing such systems can now spend more time curled up with the Hoke Corrosion Chart.*

With this extra time, many have dreamed up weird applications for the Hoke 440 Series bellows seal valve, trying to snare us in our own semantics. In a rash moment, we boasted that this valve could be modified for almost any application. Actually, the 440 can be modified to work at high pressures (up to 2000 psi), for high temperatures (up to 1000°F.), and for special connections such as tubing, socket welding, and silver brazing.

The cesium boiler shown above uses a modified version of the Hoke 440 series bellows seal valve.

Aside from this horn-blowing, here are the dry facts. The basic design includes a stainless steel body, inert arc-welded bellows assembly, Teflon gaskets and Teflon stem point discs. This is only the starting point. Minor modifications make so many models available that almost any problem, including liquid metal handling, can be solved.

Hear what a disbeliever said: "I did not believe that the modified valves would satisfy all my requirements, especially to keep a high vacuum of the order of 10^{-5} mmHg under a wide variation of temperatures; however, I now acknowledge that the modified Hoke 440 valves fulfilled their duty perfectly." This came from The Martin Company, where we sent 440's for use in cesium vapor up to 400°F. Special modifications made these valves readily usable on a cesium boiler and converted an infidel to the true valve.

If you work with critical high vacuum, high pressures, high temperatures and dangerous fluids, proceed with care. Ask for our Packless Valve Bulletin to reap a harvest of engineering plums.

Makes good reading if you're handling corrosive agents. Write, and we'll send you one.

FREE! A STEADY FLOW OF FACTS!

Further flow features, and interesting technical topics are carefully covered in Hoke's technical publication, the FLOW SHEET. It's free, but worth millions!

Hoke's Performance Guarantee — Every Valve Leak-Tested!

HOKE INCORPORATED
87 Piermont Road, Cresskill, N. J.

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☐ Packless Valves ☐ FREE Corrosion Slide Rule
☐ Flow Sheet ☐ Complete Catalog GC 959

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CITY _____ STATE _____

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NO EQUAL IN SIMPLICITY!

ONLY 3 MOVING PARTS IN ASCO 3-WAY SOLENOID VALVES

Millions of Trouble Free Operations . . . are the result of the simplicity designed into ASCO 3-way solenoid valves. Fewer wearing parts mean substantial savings in maintenance costs...reduction in down-time losses.

Simple in construction, ASCO 3-way solenoid valves are simplicity itself in operation—solenoid piloting of two simple diaphragms. Absolutely tight seating is a feature—no closely fitted parts or valve seat grinding are required.

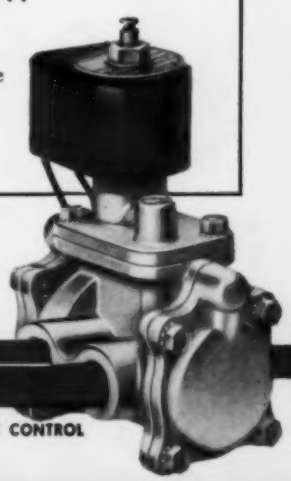
Exceptionally large flow capacity permits rapid filling and venting of cylinders . . . valves operate up to 400 cycles per minute.

Conversion from normally open to normally closed —or the reverse—takes just 30 seconds; only simple rotation of the valve bonnet required.

ASCO 3-way valves can be supplied with general purpose, water tight or explosion-proof enclosures, and may be mounted in any position. Valves are available in ⅜", ½" and ¾" sizes, all with full flow capacity provided by oversize pressure and exhaust orifices. Standard Bulletin 8316 Valves are suitable for air, gas, oil and water at pressures up to 250 p.s.i.; higher pressures can be handled by modified versions.

New! Catalog No. 202 covers the ASCO line of Solenoid Valves. Write for your copy today.

For Immediate Delivery . . .
World's largest stock of Solenoid Valves. A complete Solenoid Valve Stock List will be sent to you with your copy of Catalog No. 202.



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** From: The Art of Rapid Reading, by Walter B. Pitkin; published by Grossett & Dunlap, New York*

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